

BIM 4D Modeling

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Founder of BIMarabia



Agenda



- General introduction about BIM.
- Overview of 4D modeling .
- Typical 4D Modeling process and Information workflow
- 4D roadmap through the project lifecycle.
- 4D modeling overall benefits.



In 1962, Douglas C. Englebart wrote a paper entitled, "Augmenting Human Intellect". In it, he posited the idea of the future architect, suggested object-based design, parametric manipulation, and relational database (Bergin, 2011):

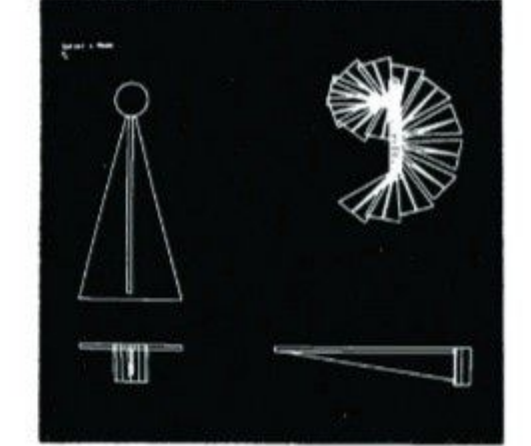
"T*he architect next begins to enter a series of specifications and data–a six-inch slab floor, twelve-inch concrete walls eight feet high within the excavation, and so on. When he has finished, the revised scene appears on the screen. A structure is taking shape. He examines it, adjusts it… These lists grow into an evermore-detailed, interlinked structure, which represents the maturing thought behind the actual design."*

History



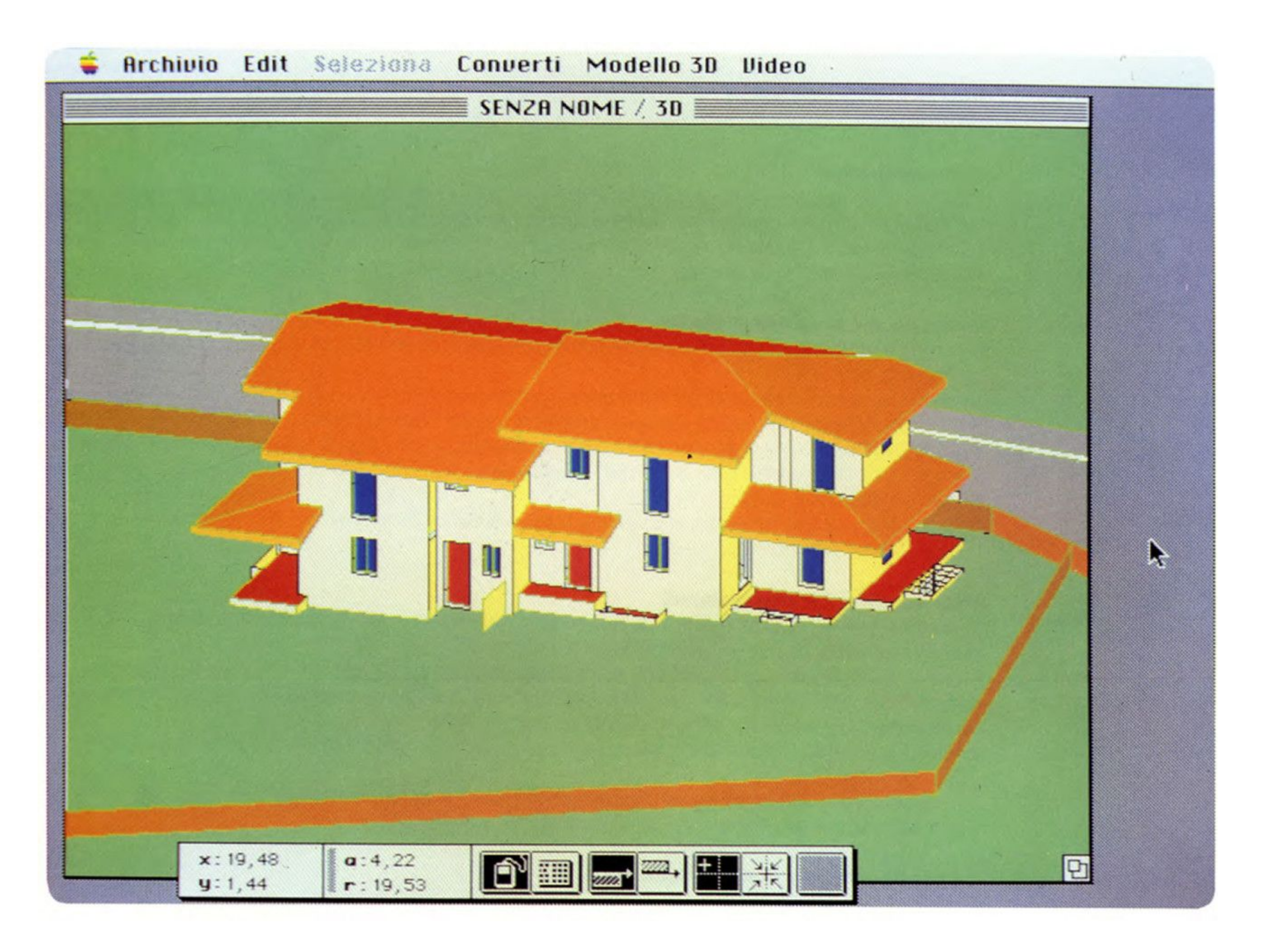
1957 — Pronto, first commercial computer-aided machining (CAM) software
1963 — Sketchpad, CAD with graphical user interface
1975 — Building Description System (BDS)
1977 — Graphical Language for Interactive Design (GLIDE)
1982–2D CAD
1984: first work with 3D models
1985 — Vectorworks
1986 — Really Universal Computer-Aided Production System (RUCAPS)
1987: saw first 4D model at Bechtel
1988: built 3D building information modeler
1992 — Building Information Model as official term
1993: built first 4D model
1995 — International Foundation Class (IFC) file format
1996: prototyped VR interface for 4D modeling
1996: started research on automating 4D modeling
1998: developed easy-to-learn 4D modeling tool (now Common Point Project 4D)
1998: started research on computer-based analysis of schedules with 4D models
1999: started research on multi-screen group interaction with 4D models
2000 — Revit
2001 — NavisWorks 2007 — Autodesk buys NavisWorks
2002 — Autodesk buys Revit
1995 — International Foundation Class (IFC) file format
2005: started research to extend 4D modeling beyond construction
To date: 4D models are applied in many project phases totaling $5B+
2006 — Digital Project





Courtesy of Architecture Research Lab

1977 — Graphical Language for Interactive Design (GLIDE)



"This screenshot from Radar CH (later ArchiCAD) shows how far BIM modeling capabilities had developed by 1984, the first major BIM release on a personal computer." Image via Graphisoft

General introduction of BIM

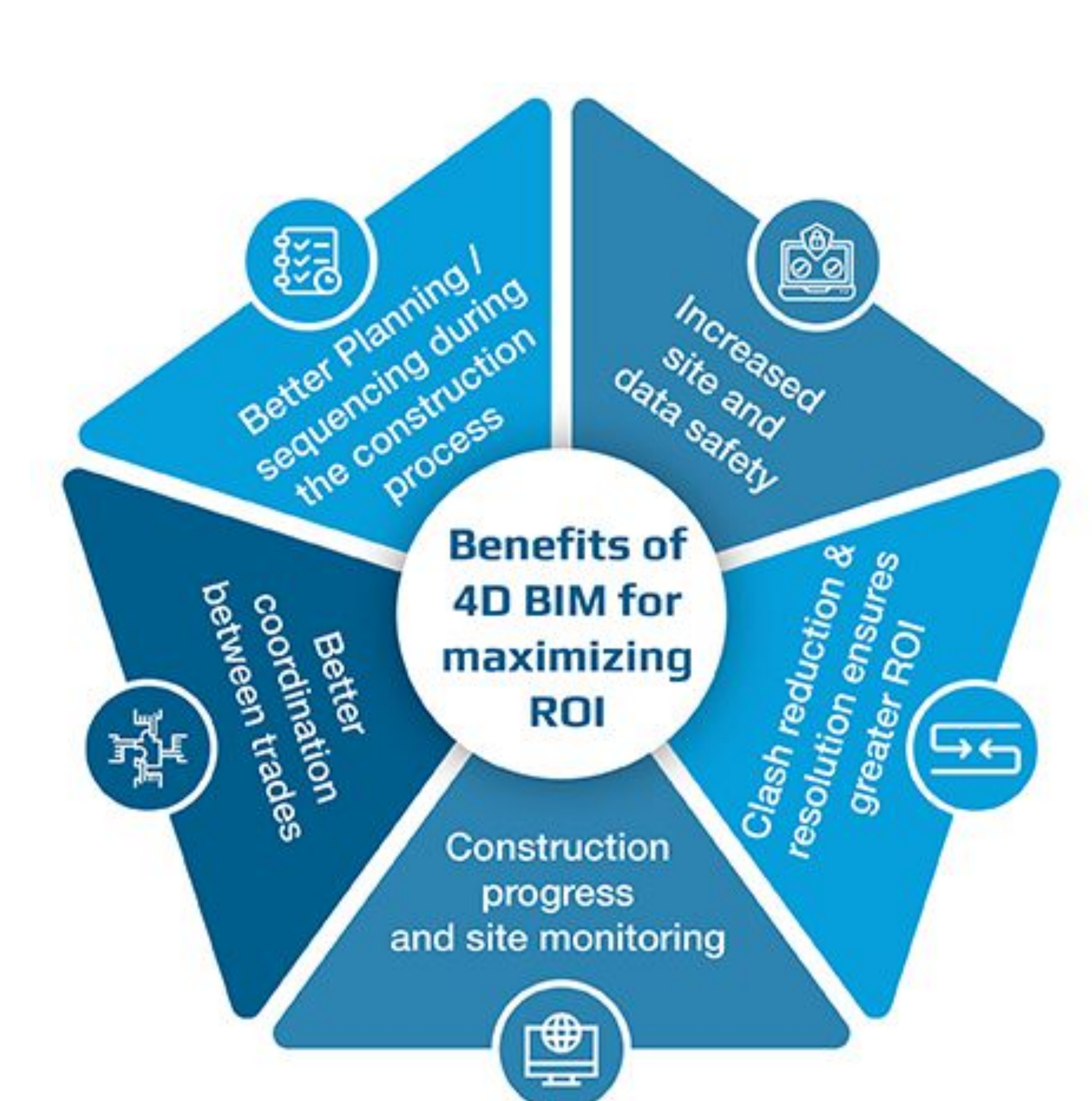


- **What is BIM :**

BIM is a process involving the generation and integration of digital representations' includes physical and functional features of construction project.

- **BIM "n" Dimensions**





Benefits of BIM implementation on University of Cambridge construction projects



Budget

The use of 4D with precast helped to keep the project on budget and on schedule

The project was completed on budget

Quality

Digital fabrication allowed improvement of project quality

Clash-detection using BIM allowed a reduction in the number of errors, enabled the team to make informed decisions and contributed to keeping the project on schedule

Schedule

The results are clear: from nothing to an enclosed, complex university building in just 24 months

Through coordination and planning, deliveries were reduced by 750 from initial estimates and worker hours were halved compared with a traditional approach

Material savings

The information and geometry available within the BIM model was utilised to get quantities of materials that could be visualised quickly and with varying options within the building

Health and safety

Use of precast and digital fabrication contributed to a 20-week reduction in the programme, as well as benefits to site management, health and safety and sustainability

Health and safety were improved: by using BIM for phase planning and site induction, the team was able to identify activities to be performed in the coming weeks



Benefits of a digitally enabled estate:

the golden thread of information and data delivering whole-life value

Design

- Use of intelligent 3D object libraries saved time during the design phase
- Use of 3D models improved quality control
- Use of 3D models improved transparency of design
- BIM assisted in the generation of quantity take-offs and cost estimates, allowing a more accurate estimate
- Visualisation supported design review and allowed quicker review against the Employer's Information Requirements (EIR), design standards and H&S
- Use of 3D models supported powerful visualisation
- The 3D BIM model was used for sustainability analysis, allowing for design optimisation
- Clash-detection workshops reduced re-work and allowed for the identification of major clashes between the different pieces of design
- The BIM model was used to define the most effective structural option based on design specifications
- Use of a Common Data Environment (CDE) improved collaboration and allowed for time savings
- Use of BIM increased the understanding of design by all stakeholders and reduced the number of project technical requests
- Use of a CDE allowed transparent audit trail in information delivery timeline

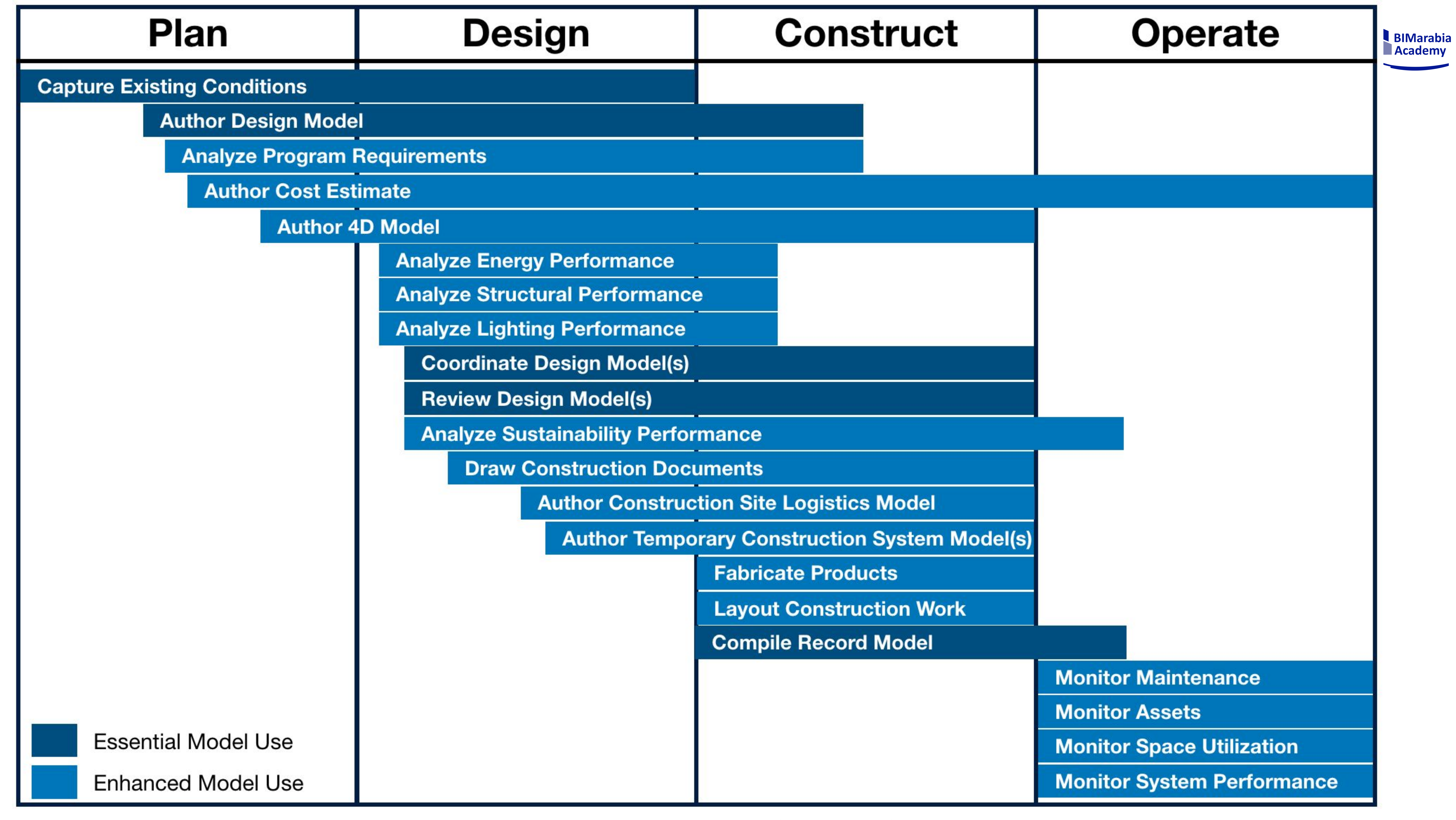
Build

- The structured data allowed quicker verification against requirements/specification
- Accurate and complete data improving quality of bids, reducing risk allowances in target prices and lump sum bids
- BIM use in coordination led to a reduction in rework, allowing for time and cost savings
- Use of hand-held devices for site inspections with 3D model visualisation and automatic information upload to CDE allowed easier inspection of construction works and spotting of defects
- The early involvement of the main contractor improved construction
- Use of digital technologies for snagging made it easier to inspect construction and to spot defects
- Phase planning improved H&S on site
- BIM level 2 allowed better quality of data and quicker exchange
- Use of 4D allowed better monitoring of the project's sequence/programme
- Virtual construction reduced errors

Operate

- Input of a populated asset data set into CAFM systems – saving time and avoid duplication
- Maintenance activities will be conducted in a safer way
- Better organizational and strategic planning from more complete and accurate asset information
- Maintenance activities will be better planned and it will be possible to track maintenance history

BIM Benefits



Common Model Uses by Project Phase

Note: Dark Blue are Essential Model Uses as defined in the National BIM Guidelines for Owners

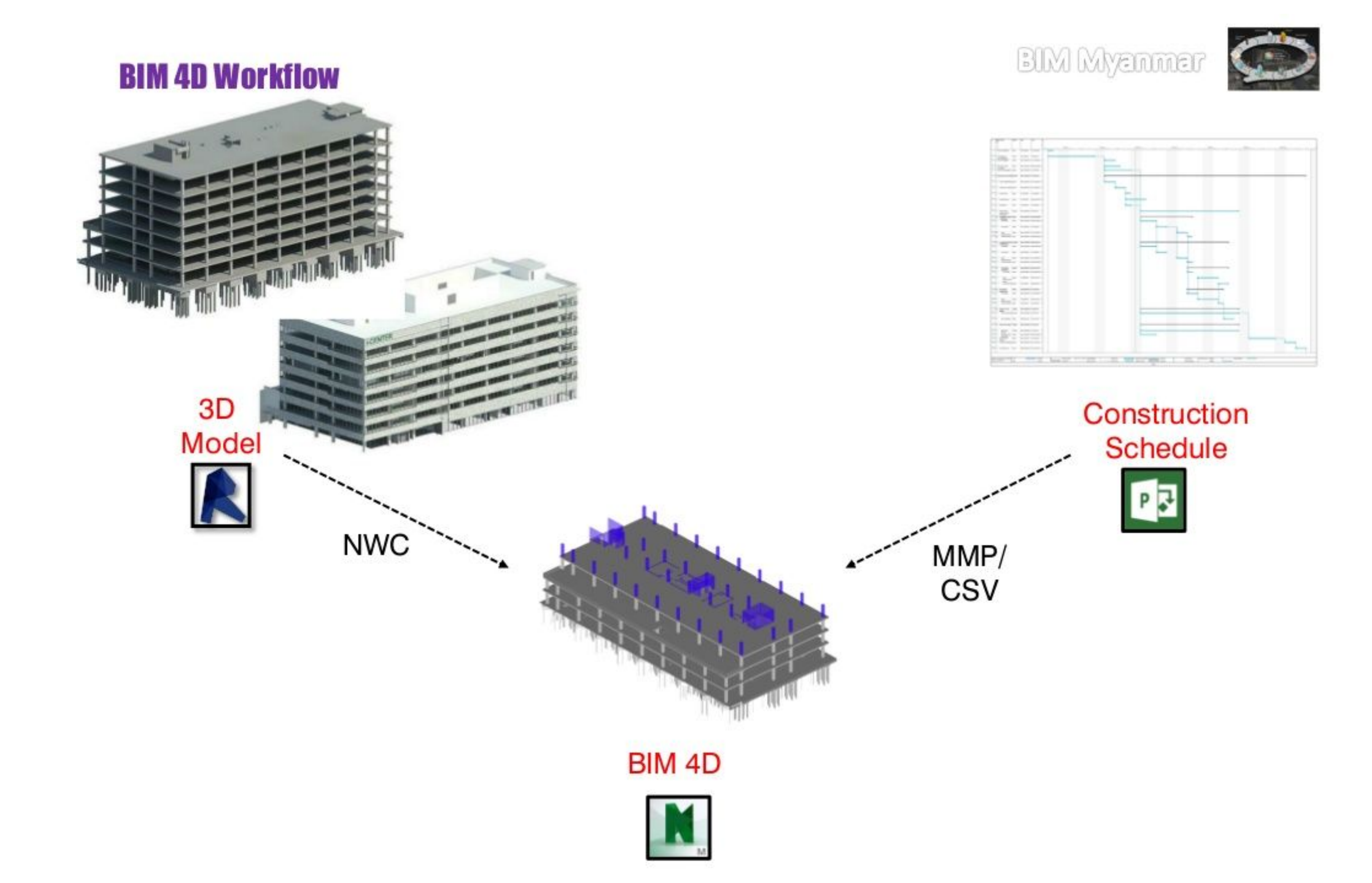

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Input & v Output



a.Input : 3D model , material , LOD , schedule , etc...
b.Tools/techniques : Software , workflow , etc...
c.Output : 4D advanced simulation video for project management purpose or realistic fancy presentation for marketing purpose.





Work Scheduling

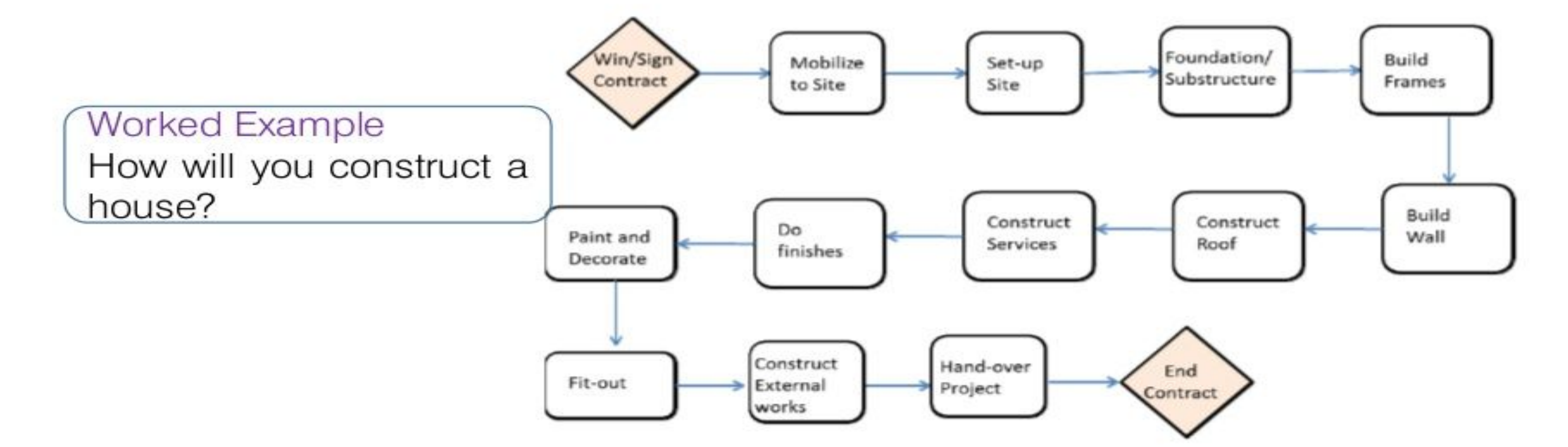
- Your goal is to:

– Create a **logical flow of work** from start to finish

– Plug-in **adequate resources** (plant and tools, labour, supervision and materials) to undertake the work as envisioned

– Determine the effective **duration for each task** i.e. *calculated duration + natural setting time + contingency factor = actual duration*

– **Avoid** waiting, idleness, conflicts and rework as much as you can





Scheduling

Primavera P6

Microsoft Project

Excel

Models

IMPORT

IMPORT

Using Dates: Best

Using Dates: Baseline - New Project Baseline

EXPORT



Import 3D model elements into 4D tool

Import construction schedule data into 4D tool

Link components (or groups of components) to the activities on the project schedule

4D simulation and analysis tool

Completed 4D model

Stage 1

Stage 2

Stage 3

Simulation OK?

No

Yes

End

Or

Amend simulation criteria

Amend source data

Modify 3D model and/or project schedule inputs

Figure 12 Creating a 4D sequence by linking a 3D model to a construction schedule

Gantt Chat (MS Project)



xx
Vastuuhenkilö: xx

Janakaavio / Talotekniikka
versio 3.10.2005 19:27

	Hierarkia	Selite	Määrä	Yksikkö	Kesto	Aloitushetki
1	+1	Sähköputkitukset			280	28.9.2000
4	+2	Pohjaviemärit			9.9	13.10.2000
7	+3	Pumppaamot			24	18.10.2000
9	+4	IV-nousuhormit			120	14.11.2000
12	+5	Lämmönjakohuoneen asennukset			60	14.11.2000
14	+6	Sprinklernousut			20	21.11.2000
17	+7	Pystynousut vesi ja viemäri			53	28.11.2000
20	+8	Lämpöjohtonousut			60	28.11.2000
23	+9	Sprinklervaakarungot 1.kkrs			43.3	28.11.2000
26	+10	Jäähdytyspystynousut			90	28.11.2000
29	+11	Sprinklervaakarungot 2.-7.krs			60	5.12.2000
42	+12	Kaapelihyllyt 1.kkrs-1.krs			20	20.12.2000
47	+13	IV-vaakarungot 2.-7.krs			120	27.12.2000
60	+14	Jäähdytysvaakavedot			120	3.1.2001
73	+15	Johtokanava-asennukset 2.-7.krs			60	16.2.2001
86	+16	IV-konehuoneasennukset			80	22.2.2001
89	+17	Nousujohtoasennukset ja kytkennät			120	23.2.2001
92	+18	Kaapelihyllyt 2.-ukrs			124.8	23.2.2001
106	+19	PALOILMOITINJÄRJESTELMÄ			193.1	15.3.2001
109	+20	Valaisimet			130	29.3.2001
123	+21	Jäähdytyspalkit			90	5.4.2001
136	+22	IV-vaakarungot 1.krs			30	12.4.2001
141	+23	IV-haaroitukset 2.-7.krs			90	12.4.2001
154	+24	IV-haaroitukset 1.krs, neukkarit			12	12.4.2001
157	+25	Pääkeskusasennus			35	18.4.2001
159	+26	Ryhmäkeskukset			15	18.4.2001
176	+27	Haaroitukset vesi ja viemäri 2.-7.krs			62.5	18.4.2001
190	+28	Pumppuryhmät			20	18.4.2001
193	+29	IV-konehuoneiden sähkötyöt			140	23.4.2001

2000 | 2001
Syy | Lok | Mar | Jou | Tam | Hel | Maa | Huh | Tou | Kes | Hei | Elo | Syy

Suunnittelutila
DYNAProject v2.2.04





Element Task ID (Revit)

BIM Myanmar

Properties

Multiple Families Selected

Structural Foundati | Edit Type

Identity Data	
Comments	
Mark	
4D_TaskID	A100
Phasing	
Phase Created	New Constr...
Phase Demoli...	None

Properties help | Apply

Zone A Level 1 Foundation

A 1 00

- Zone Area
- Floor Level
- Element Type
  - 00 – Foundation
  - 10 – Beam
  - 20 – Floor
  - 30 – Column/Wall

Properties

Floor Generic 225mm

Floors (2) | Edit Type

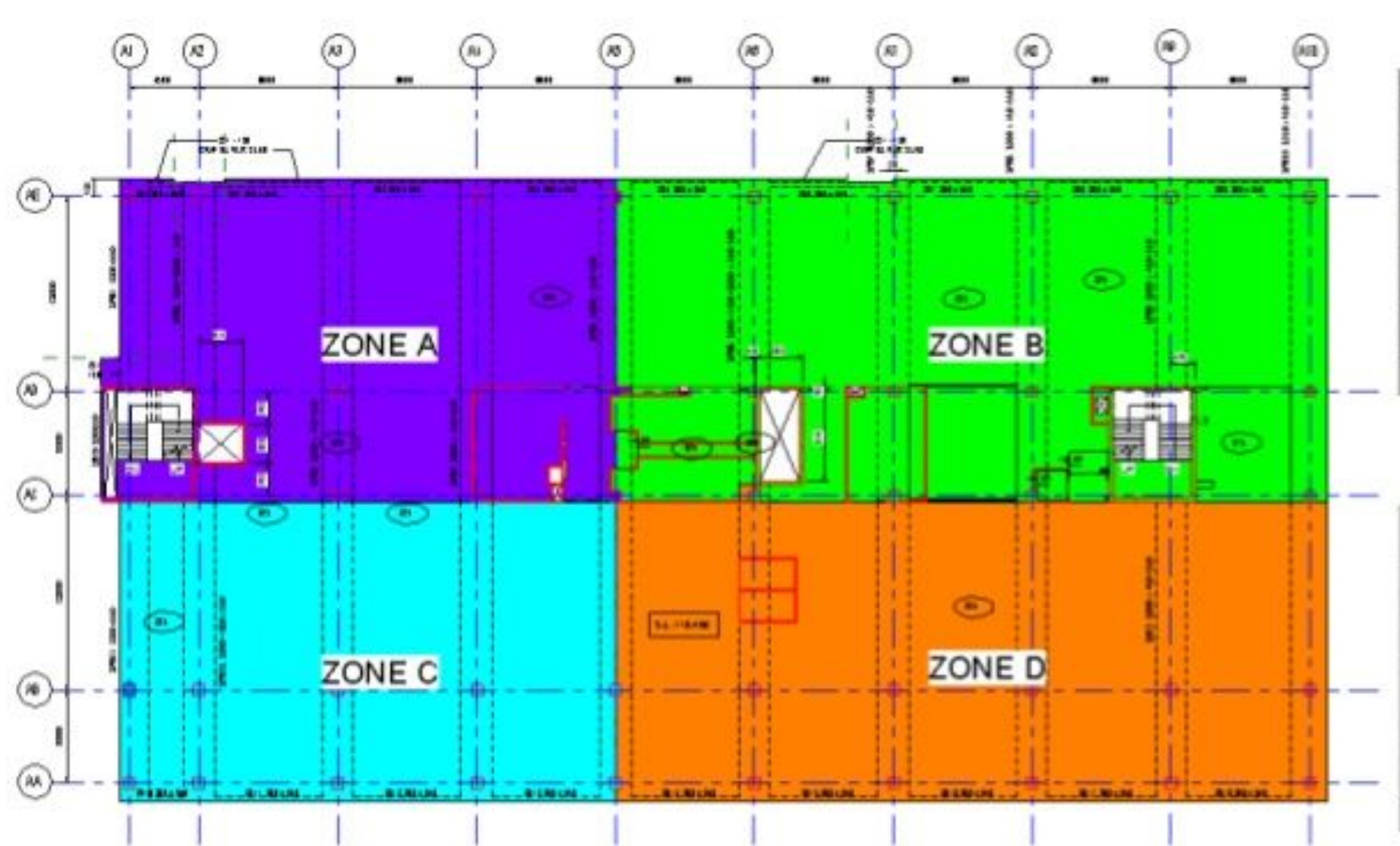
Identity Data	
Comments	
Mark	
4D_TaskID	C320
Phasing	
Phase Created	New Constr...
Phase Demoli...	None

Properties help | Apply

Zone C Level 3 Floor



Zoning (Construction Schedule)



Structural Framing Material Takeoff			
4D_TaskID	Level	Count	Material: Volume
A110	Level 1	57	16.77 m³
A210	Level 2	29	60.14 m³
A310	Level 3	30	59.65 m³
A410	Level 4	29	58.79 m³
A510	Level 5	29	58.38 m³
A610	Level 6	29	58.38 m³
A710	Level 7	29	58.38 m³
AM10	Mech Roof	34	59.52 m³
		266	430.02 m³

Structural Framing Material Takeoff			
4D_TaskID	Level	Count	Material: Volume
B110	Level 1	67	23.28 m³
B210	Level 2	24	64.33 m³
B310	Level 3	24	64.36 m³
B410	Level 4	24	64.17 m³
B510	Level 5	24	64.48 m³
B610	Level 6	24	64.50 m³
B710	Level 7	24	64.50 m³
BM10	Mech Roof	27	64.18 m³
		238	473.80 m³

Material Take Off for "Beam"

Structural Framing Material Takeoff			
4D_TaskID	Level	Count	Material: Volume
C110	Level 1	32	9.43 m³
C210	Level 2	19	62.91 m³
C310	Level 3	27	65.57 m³
C410	Level 4	19	41.40 m³
C510	Level 5	20	41.39 m³
C610	Level 6	20	41.39 m³
C710	Level 7	20	41.39 m³
CM10	Mech Roof	19	42.65 m³
		176	346.12 m³

Structural Framing Material Takeoff			
4D_TaskID	Level	Count	Material: Volume
D110	Level 1	35	11.72 m³
D210	Level 2	22	67.82 m³
D310	Level 3	36	66.84 m³
D410	Level 4	22	46.43 m³
D510	Level 5	21	46.01 m³
D610	Level 6	21	45.99 m³
D710	Level 7	21	45.99 m³
DM10	Mech Roof	23	46.22 m³
		201	377.02 m³

Structural Column Material Takeoff			
4D_TaskID	Level	Count	Material: Vol
A101	Level 1	21	1.50 m³
A130	Level 1	22	25.74 m³
A230	Level 2	23	21.69 m³
A330	Level 3	23	21.69 m³
A430	Level 4	23	21.69 m³
A530	Level 5	23	21.69 m³
A630	Level 6	23	21.69 m³
A730	Level 7	23	26.51 m³
AM30	Mech Roof	1	0.12 m³
		182	162.33 m³

Structural Column Material Takeoff			
4D_TaskID	Level	Count	Material: Vol
B101	Level 1	32	2.14 m³
B130	Level 1	27	29.66 m³
B230	Level 2	27	24.93 m³
B330	Level 3	28	24.93 m³
B430	Level 4	28	24.93 m³
B530	Level 5	28	24.93 m³
B630	Level 6	28	24.93 m³
B730	Level 7	29	30.29 m³
BM30	Mech Roof	3	0.29 m³
		230	187.06 m³

Structural Column Material Takeoff			
4D_TaskID	Level	Count	Material: Vol
C101	Level 1	20	1.67 m³
C130	Level 1	20	23.40 m³
C230	Level 2	20	19.19 m³
C330	Level 3	10	9.86 m³
C430	Level 4	10	9.86 m³
C530	Level 5	10	9.86 m³
C630	Level 6	10	9.86 m³
C730	Level 7	10	12.99 m³
		110	96.68 m³

Structural Column Material Takeoff			
4D_TaskID	Level	Count	Material: Vol
D101	Level 1	20	2.16 m³
D130	Level 1	20	23.54 m³
D230	Level 2	20	19.19 m³
D330	Level 3	10	9.86 m³
D430	Level 4	10	9.86 m³
D530	Level 5	10	9.86 m³
D630	Level 6	10	9.86 m³
D730	Level 7	10	12.99 m³
		110	97.32 m³

Material Take Off for "Column"



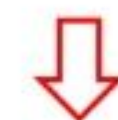
Construction Project Planning Workflow

Task ID (Schedule)

Task ID	Type	Title	Duration	Expected Start	Expected End
1	Construct	Preconstruction	5	16/09/2012	21/09/2012
A100	Construct	Zone A Level 1: Foundation	5	22/09/2012	27/09/2012
A101	Construct	Zone A Level 1: Stump	2	28/09/2012	30/09/2012
A110	Construct	Zone A Level 1: Beams	8	01/10/2012	09/10/2012
A120	Construct	Zone A Level 1: Floor Deck	5	10/10/2012	15/10/2012
A130	Construct	Zone A Level 1: Columns/Walls	5	16/10/2012	21/10/2012
A210	Construct	Zone A Level 2: Beams	8	22/10/2012	30/10/2012
A220	Construct	Zone A Level 2: Floor Deck	5	31/10/2012	05/11/2012
A230	Construct	Zone A Level 2: Columns/Walls	5	06/11/2012	11/11/2012
A310	Construct	Zone A Level 3: Beams	8	12/11/2012	20/11/2012
A320	Construct	Zone A Level 3: Floor Deck	5	21/11/2012	26/11/2012
A330	Construct	Zone A Level 3: Columns/Walls	5	27/11/2012	02/12/2012
A410	Construct	Zone A Level 4: Beams	8	03/12/2012	11/12/2012
A420	Construct	Zone A Level 4: Floor Deck	5	12/12/2012	17/12/2012
A430	Construct	Zone A Level 4: Columns/Walls	5	18/12/2012	23/12/2012
A510	Construct	Zone A Level 5: Beams	8	24/12/2012	01/01/2013
A520	Construct	Zone A Level 5: Floor Deck	5	02/01/2013	07/01/2013
A530	Construct	Zone A Level 5: Columns/Walls	5	08/01/2013	13/01/2013
A610	Construct	Zone A Level 6: Beams	8	14/01/2013	22/01/2013
A620	Construct	Zone A Level 6: Floor Deck	5	23/01/2013	28/01/2013
A630	Construct	Zone A Level 6: Columns/Walls	5	29/01/2013	03/02/2013
A710	Construct	Zone A Level 7: Beams	8	04/02/2013	12/02/2013
A720	Construct	Zone A Level 7: Floor Deck	5	13/02/2013	18/02/2013
A730	Construct	Zone A Level 7: Columns/Walls	5	19/02/2013	24/02/2013
AM10	Construct	Zone A Mech Roof: Beams	8	25/02/2013	05/03/2013
AM20	Construct	Zone A Mech Roof: Floor Deck	5	06/03/2013	11/03/2013
AM30	Construct	Zone A Mech Roof: Columns/Walls	5	12/03/2013	17/03/2013



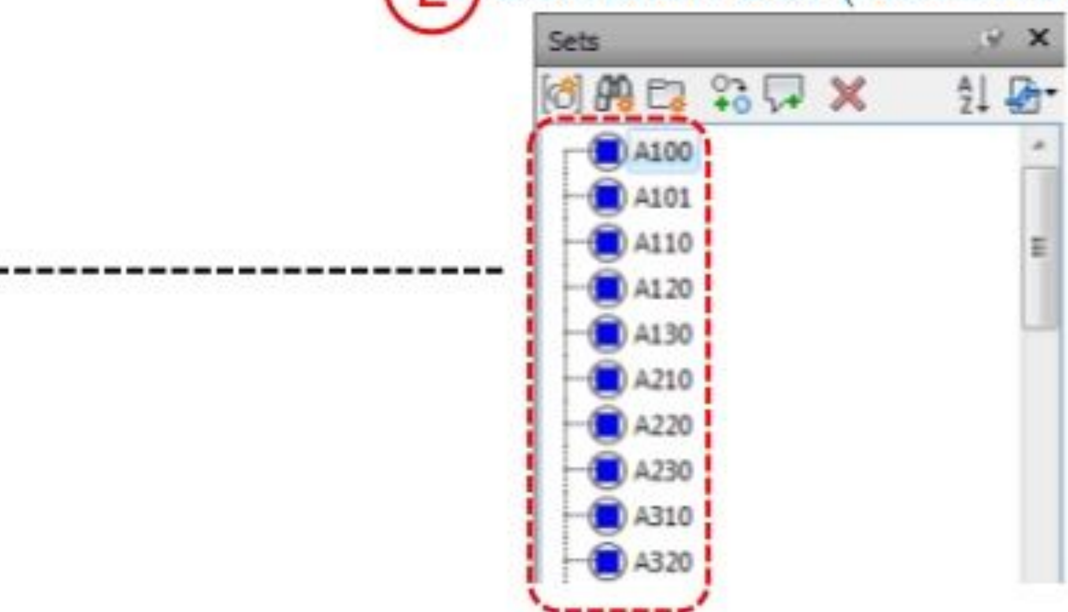
Category	Property	Condition	Value
Element	4D_TaskID	=	A100



Selection Tree (Navisworks)









Auto Attach Using Rules (Navisworks)

1

TimeLiner

Tasks | Data Sources | Configure | Simulate

Add | Delete | Refresh

- CSV Import
- Microsoft Project MPX
- Microsoft Project 2007-2013
- Primavera Project Management 6-8
- Primavera P6 (Web Services)
- Primavera P6 V7(Web Services)
- Primavera P6 V8.3(Web Services)

2

Field Selector

CSV Import Settings

- Row 1 contains headings
- Automatically detect date/time format
- Use specific date/time format

dd/MM/yyyy h:mm tt

Column	External Fiel
Task Name	Title
Display ID	Task ID
Task Type	Type
Synchronization ID	Task ID
Planned Start Date	Expected Start
Planned End Date	Expected End
Actual Start Date	
Actual End Date	
Material Cost	
Labor Cost	
Equipment Cost	

Reset All | OK | Cancel | Help

3

TimeLiner

Tasks | Data Sources | Configure | Simulate

Add Task | Attach

4

TimeLiner Rules

- Map TimeLiner Tasks from Column Name to Items with the same name, Matching
- Map TimeLiner Tasks from Column Name to Selection Sets with the same name, I
- Map TimeLiner Tasks from Column Name to Layers with the same name, Matching
- ☑ Map TimeLiner Tasks from Column Display ID to Selection Sets with the same na

New | Edit | Delete | Apply Rules

5

TimeLiner

Tasks | Data Sources | Configure | Simulate

Add Task | Attach | Zoom:

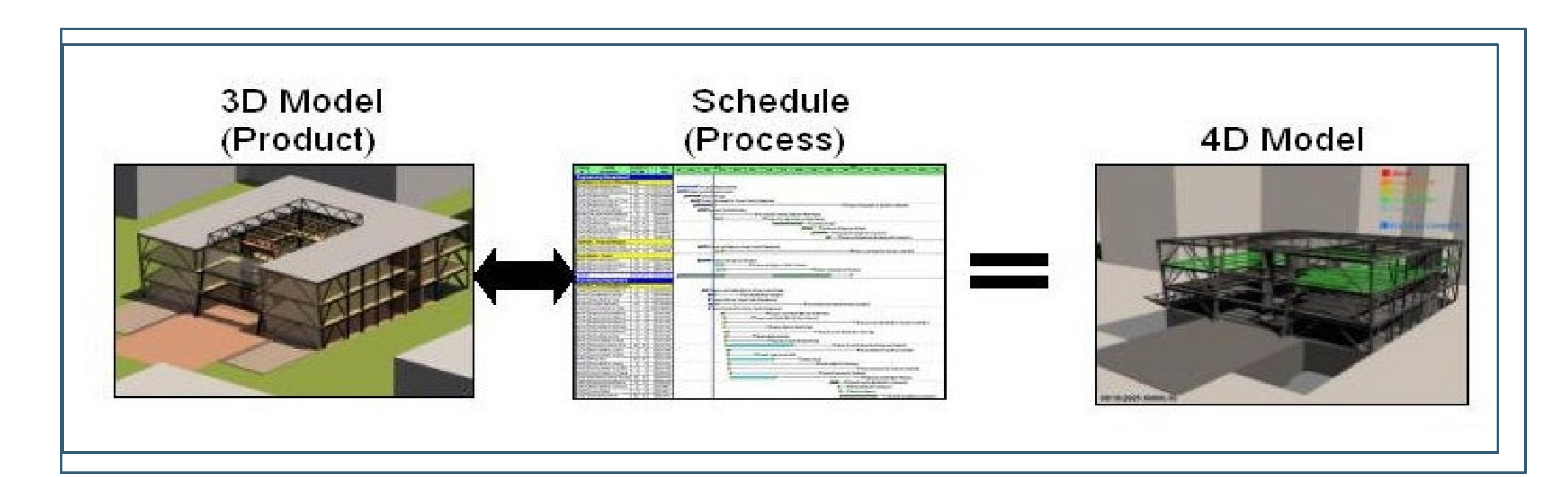
Active	Name	Status	Planned Start	Planned End	Actual Start	Actual End	Task Type	Attached
☑	New Data Source (Root)		16/09/2012	24/03/2013	N/A	N/A		
☑	Preconstruction		16/09/2012	21/09/2012	N/A	N/A	Construct	
☑	Zone A Level 1: Foundation		22/09/2012	27/09/2012	N/A	N/A	Construct	Sets->A100
☑	Zone A Level 1: Stump		28/09/2012	30/09/2012	N/A	N/A	Construct	Sets->A101
☑	Zone A Level 1: Beams		01/10/2012	09/10/2012	N/A	N/A	Construct	Sets->A110
☑	Zone A Level 1: Floor Deck		10/10/2012	15/10/2012	N/A	N/A	Construct	Sets->A120
☑	Zone A Level 1: Columns/Walls		16/10/2012	21/10/2012	N/A	N/A	Construct	Sets->A130
☑	Zone A Level 2: Beams		22/10/2012	30/10/2012	N/A	N/A	Construct	Sets->A210
☑	Zone A Level 2: Floor Deck		31/10/2012	05/11/2012	N/A	N/A	Construct	Sets->A220
☑	Zone A Level 2: Columns/Walls		06/11/2012	11/11/2012	N/A	N/A	Construct	Sets->A230
☑	Zone A Level 3: Beams		12/11/2012	20/11/2012	N/A	N/A	Construct	Sets->A310
☑	Zone A Level 3: Floor Deck		21/11/2012	26/11/2012	N/A	N/A	Construct	Sets->A320
☑	Zone A Level 3: Columns/Walls		27/11/2012	02/12/2012	N/A	N/A	Construct	Sets->A330
☑	Zone A Level 4: Beams		03/12/2012	11/12/2012	N/A	N/A	Construct	Sets->A410
☑	Zone A Level 4: Floor Deck		12/12/2012	17/12/2012	N/A	N/A	Construct	Sets->A420
☑	Zone A Level 4: Columns/Walls		18/12/2012	23/12/2012	N/A	N/A	Construct	Sets->A430
☑	Zone A Level 5: Beams		24/12/2012	01/01/2013	N/A	N/A	Construct	Sets->A510
☑	Zone A Level 5: Floor Deck		02/01/2013	07/01/2013	N/A	N/A	Construct	Sets->A520
☑	Zone A Level 5: Columns/Walls		08/01/2013	13/01/2013	N/A	N/A	Construct	Sets->A530
☑	Zone A Level 6: Beams		14/01/2013	22/01/2013	N/A	N/A	Construct	Sets->A610
☑	Zone A Level 6: Floor Deck		23/01/2013	28/01/2013	N/A	N/A	Construct	Sets->A620

Overview of 4D modeling

BIMarabia Academy

- **4D Modeling:** simulating the planning sequence of construction activities and space requirements on a building site (Visualization of the construction schedule).
- **Types of 4D models:**

1- Stand Alone 4D model



4D – Schedule Integration

- Integration of the BIM model with Project Management schedules
- Model Phasing, Time-lining, Tabular Reports and Visualized output to facilitate in understanding how the project is planned to progress across its construction lifecycle
- Planned versus actual progress on site



Overview of 4D modeling

BIMarabia Academy

2- Comparative 4D Model:

- <u>Type 1</u> (1 3D Model with 2 Schedules)

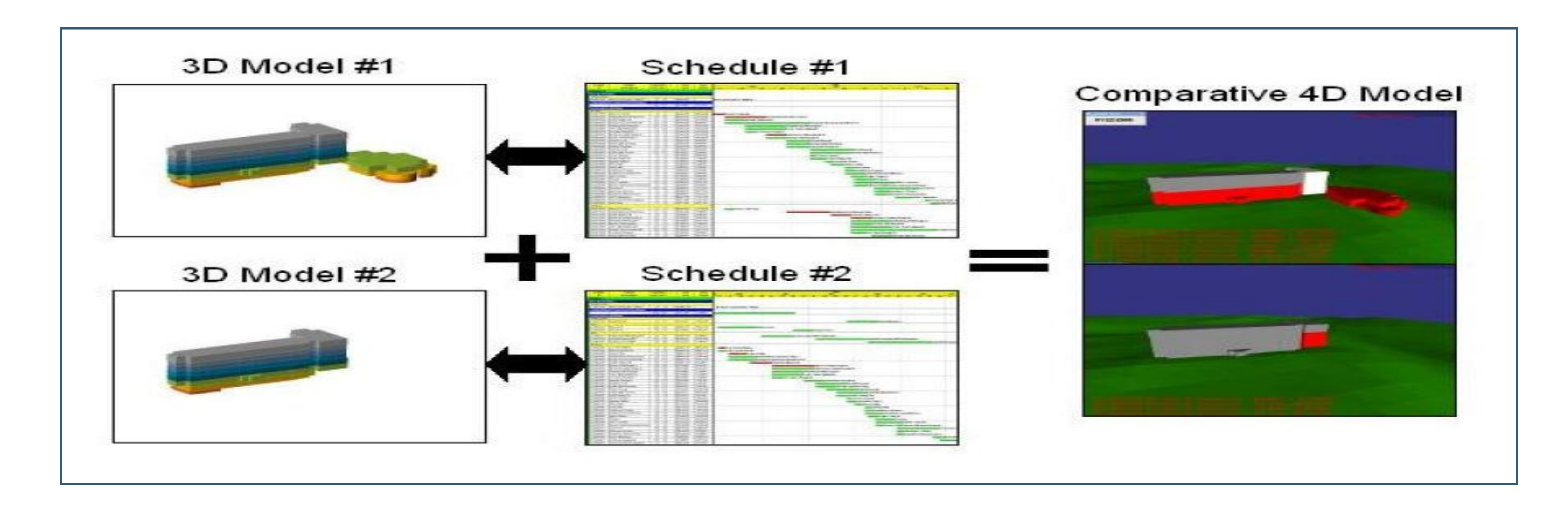


Overview of 4D modeling

Arabia Academy
DAVIDSON

2- Comparative 4D Model:

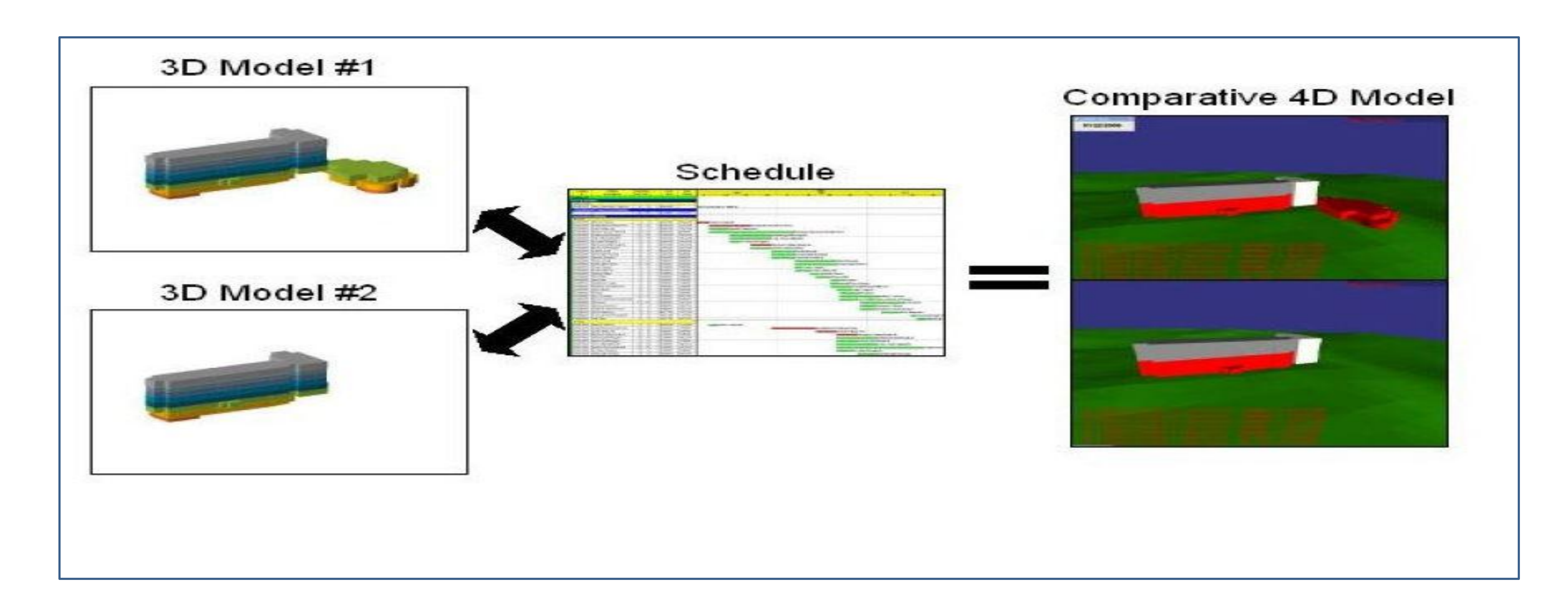
- Type 2 (2 3D Model with 2 Schedules)



Overview of 4D modeling

2- Comparative 4D Model:

- Type 3 (2 3D Model with 1 Schedule)



Typical 4D Modeling process



4D Modeling process : Combines space (3D data; X, Y, and Z) and time Line data, into a single integrated model of the project delivery approach and execution.

Engineering & Design Systems

CAD AUTODESK Bentley AVEVA INTERGRAPH openBIM

BIG DATA SYNCHRO SOFTWARE

Project ORACLE PRIMAVERA Excel

Project Planning & Scheduling Systems

4D Modeling Information WorkFlow



4D modeling workflow

The 4D specialist
Coordination and planning skills

3D/BIM models from project team

Construction schedule

4D tool/Software

Group or reorganize model components

Assign activity types for visual behavior

Manually or auto-link components or component groups to construction activities

The 4D specialist
Graphic Design skills

4D model

Manual Link, Changes must be done by scheduler automatically

The 4D specialist 4D modeling ,Coordination , planning , 3D modeling and 4D modeling skills

Digital links, changes are updated

Stage 1

Stage 2

Stage 3

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



1

CREATE

IMPORT THE 3D MODEL AND CREATE OR IMPORT THE SCHEDULE. LINK THE TWO TO CREATE YOUR 4D MODEL.

CPM SCHEDULE + 3D MODEL/DATA

IMPORT
EXPORT
IMPORT

PRO

4D MODEL

ADD/MODIFY WBS DETAIL

RESOURCE ALLOCATION

2

BASELINE

TEMPORARY WORKS & SITE LOGISTICS

INTERNAL TEAM REVIEW

CONSTRUCTABILITY REVIEW

VALIDATE

3

OPTIMIZE

'WHAT IF' SCENARIOS

DYNAMIC CLASH DETECTION

WORK ZONE

4D MODEL

- RISK ANALYSIS
- SAFETY ANALYSIS
- DIGITAL REHEARSAL

ENGAGE

REVIEW THE 4D SIMULATION WTH THE PROJECT DELIVERY TEAM INCLUDING E, H & S. PRACTICE THE PLAN UNTIL THE TEAM IS CONFIDENT THE PLAN IS OPTIMIZED AND READY FOR CONSTRUCTION.

4D UPDATE

4

CONSTRUCT

4D UPDATE

LOOK AHEAD MEETINGS

PROGRESS TRACKING IN THE FIELD

4D VIEWPOINT REPORTS

COMPARE PLANNED TO ACTUAL

4D UPDATE

METRICS MEASUREMENT

DELIVER AS-BUILT MODEL

INNOVATE

REVIEW PROJECT PERFORMANCE, IDENTIFY BEST PRACTICES FOR FUTURE PROJECTS.

LESSONS LEARNED

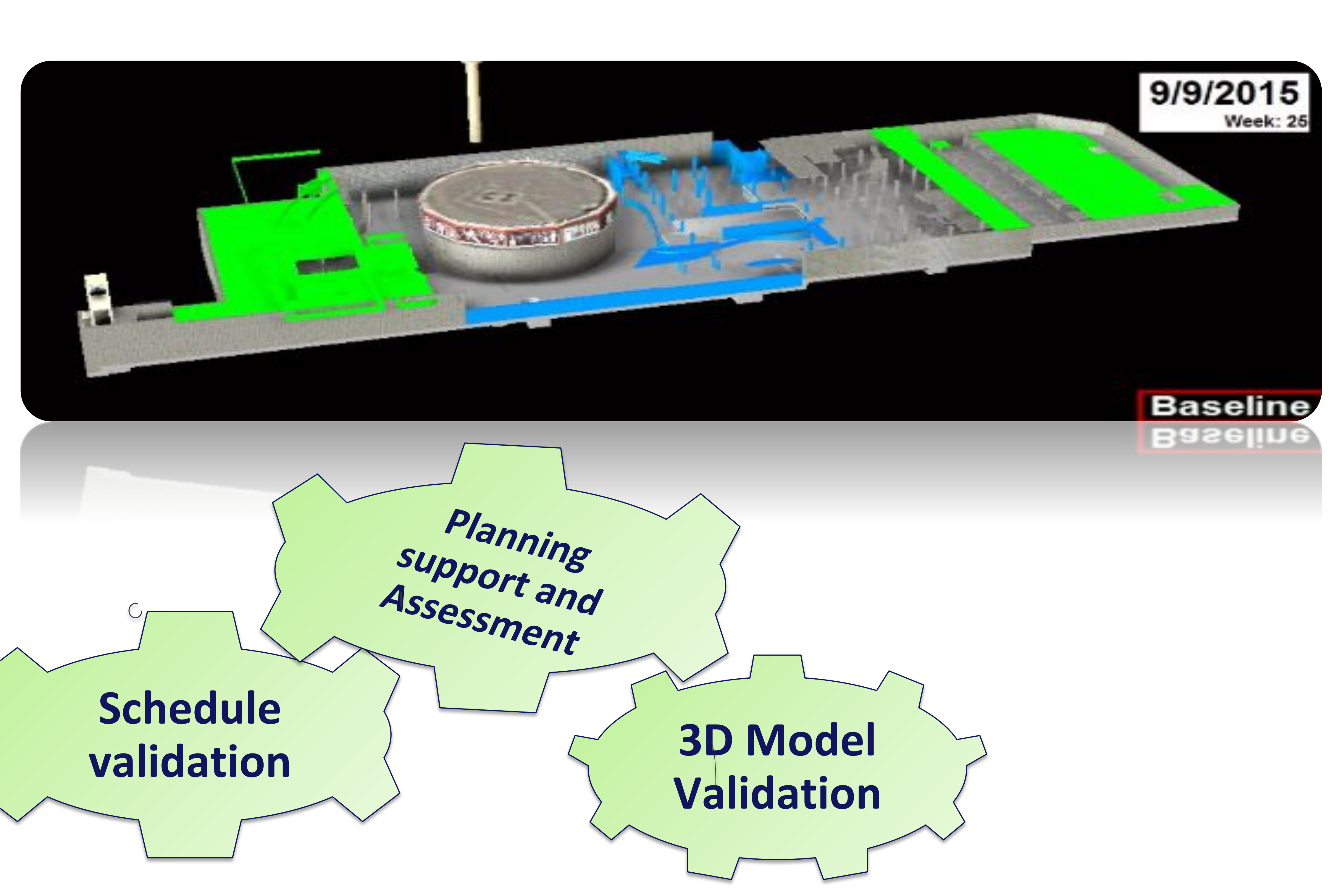
5



4D ROADMAP THROUGH THE PROJECT LIFECYCLE

Initiation Stage .1





4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Initiation Stage .1

Concrete Structure Part 1
- Plain Concrete
- Waterproofing
- Raft Slab
- Sub Vertical
- Ground Slab

Concrete Structure Part 2
- Plain Concrete
- Waterproofing
- Raft Slab
- Sub Vertical
- Ground Slab

Baseline in progress
Baseline completed

Jul			Oct			Jan 2016			Apr			Jul		
May	Jun		Aug	Sep		Nov	Dec		Feb	Mar		May	Jun		Aug	Sep
wk 8	wk 12	wk 16	wk 21	wk 25	wk 29	wk 34	wk 38	wk 43	wk 47	wk 51	wk 56	wk 60	wk 64	wk 69	wk 73	wk 7

8/1/2015
Week: 20

Baseline

Slab Casting
Foundations Waterproofing
Verticals Casting

Concrete Structure Part 3
- Plain Concrete
- Waterproofing
- Raft Slab
- Sub Vertical
- Ground Slab

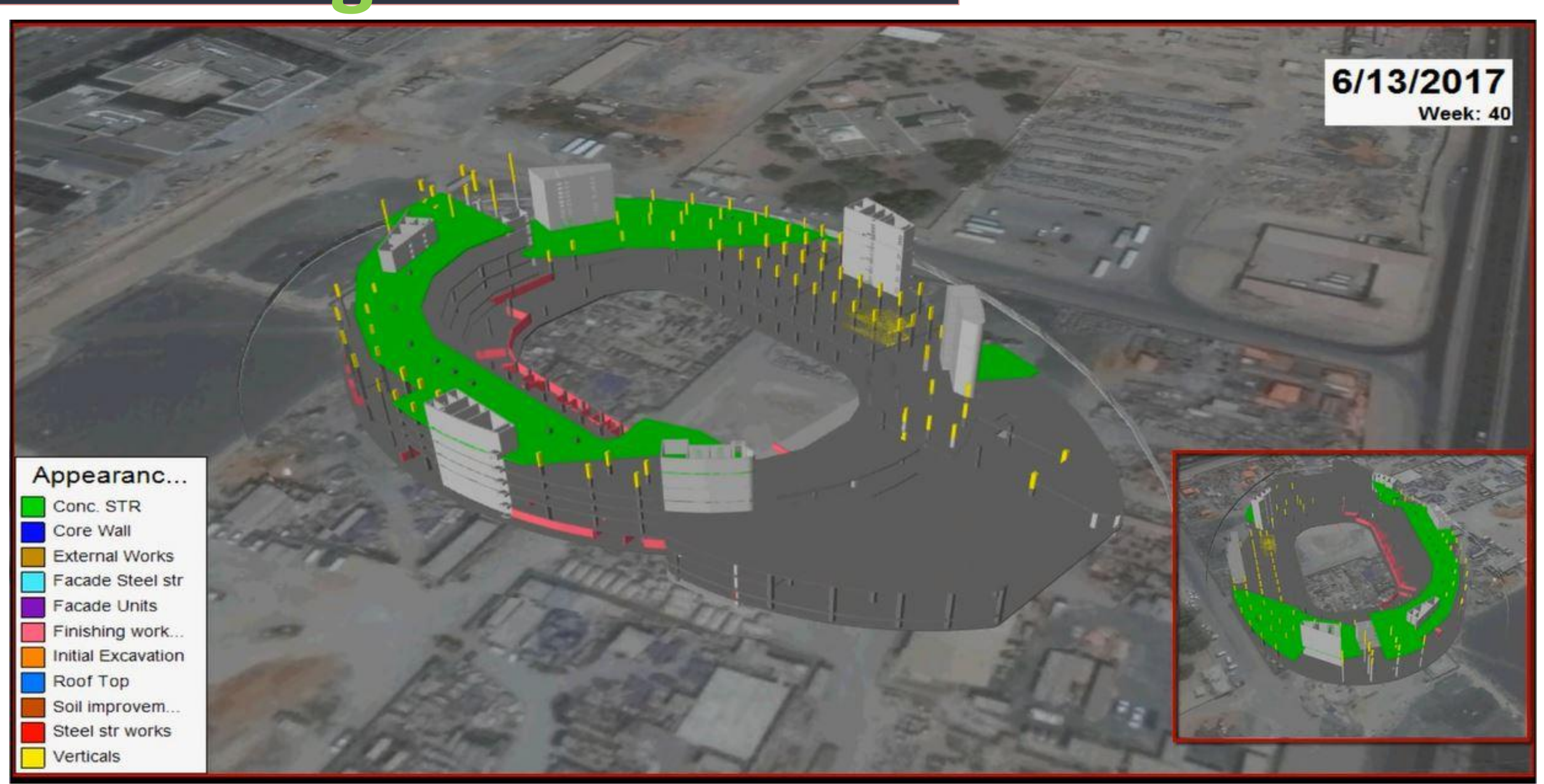
Concrete Structure Part 4
- Plain Concrete
- Waterproofing
- Raft Slab
- Sub Vertical
- Ground Slab

Slab on Grade
- Slab on GradePart 2
- Slab on GradePart 3
- Slab on GradePart 4

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Initiation Stage .1



4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Baseline Stage.2





Zone/Move Management

Construction methodology simulation

Site Coordination/ Logistics

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Baseline Stage.2

Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan 2016 | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep

wk 3 | wk 8 | wk 12 | wk 16 | wk 21 | wk 25 | wk 29 | wk 34 | wk 38 | wk 43 | wk 47 | wk 51 | wk 56 | wk 60 | wk 64 | wk 69 | wk 73 | wk 77

9/22/2015
Week: 27

6 Months progress

Museum :
1.PC completed.
2.Waterproofingcompleted.
3.Raft completed.
4.Bassment verticals completed.
5.Ground Slab in progress

Utility Building:
1.PC completed.
2.Waterproofing completed.
3.Raft completed.
4.Bassment verticals completed.
5.Ground Slab in progress

Guest House: completed.

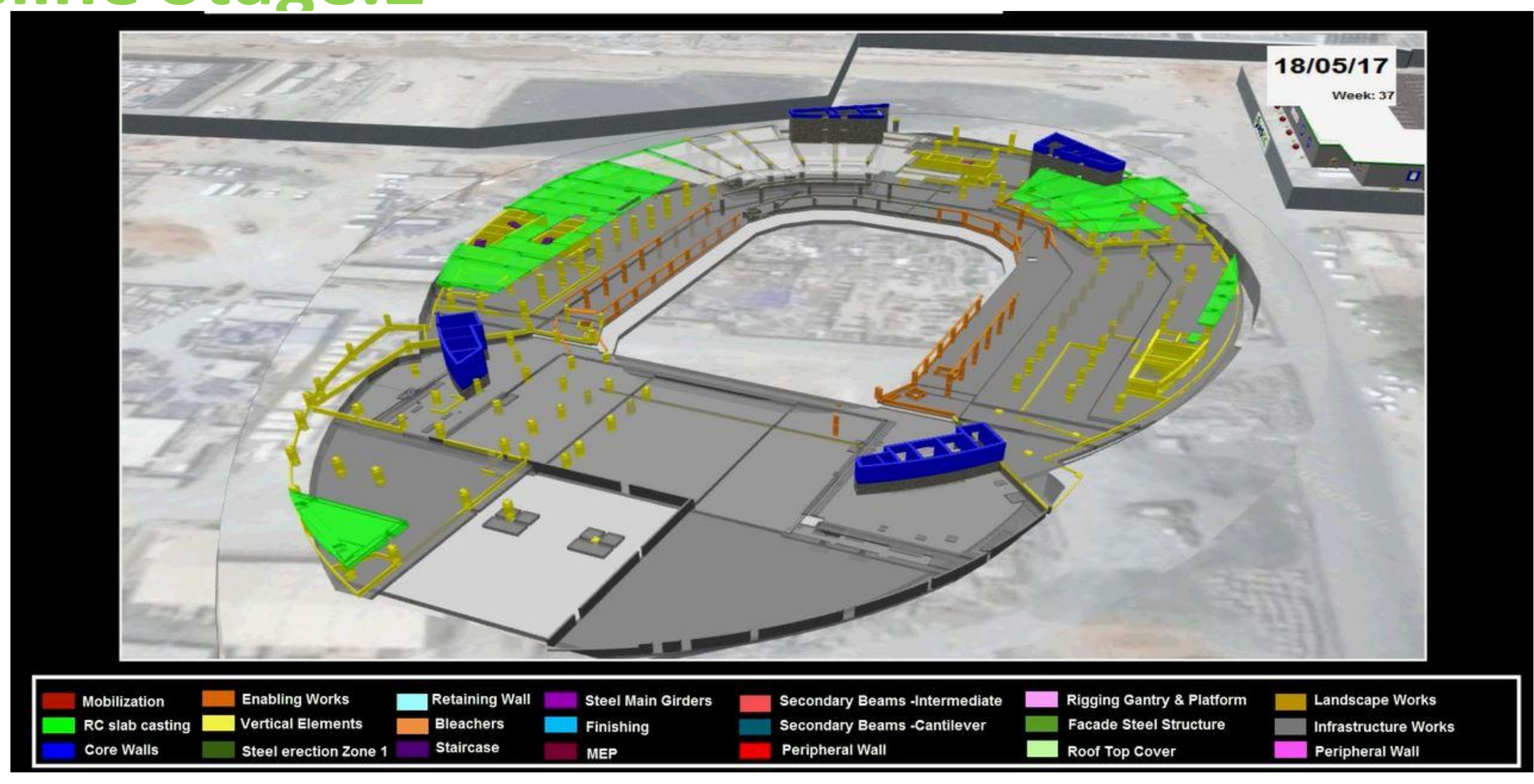
Slab Casting | Foundations Waterproofing | Verticals Casting | Mobilization | Steel Str.

Museum - Dubai

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Baseline Stage.2



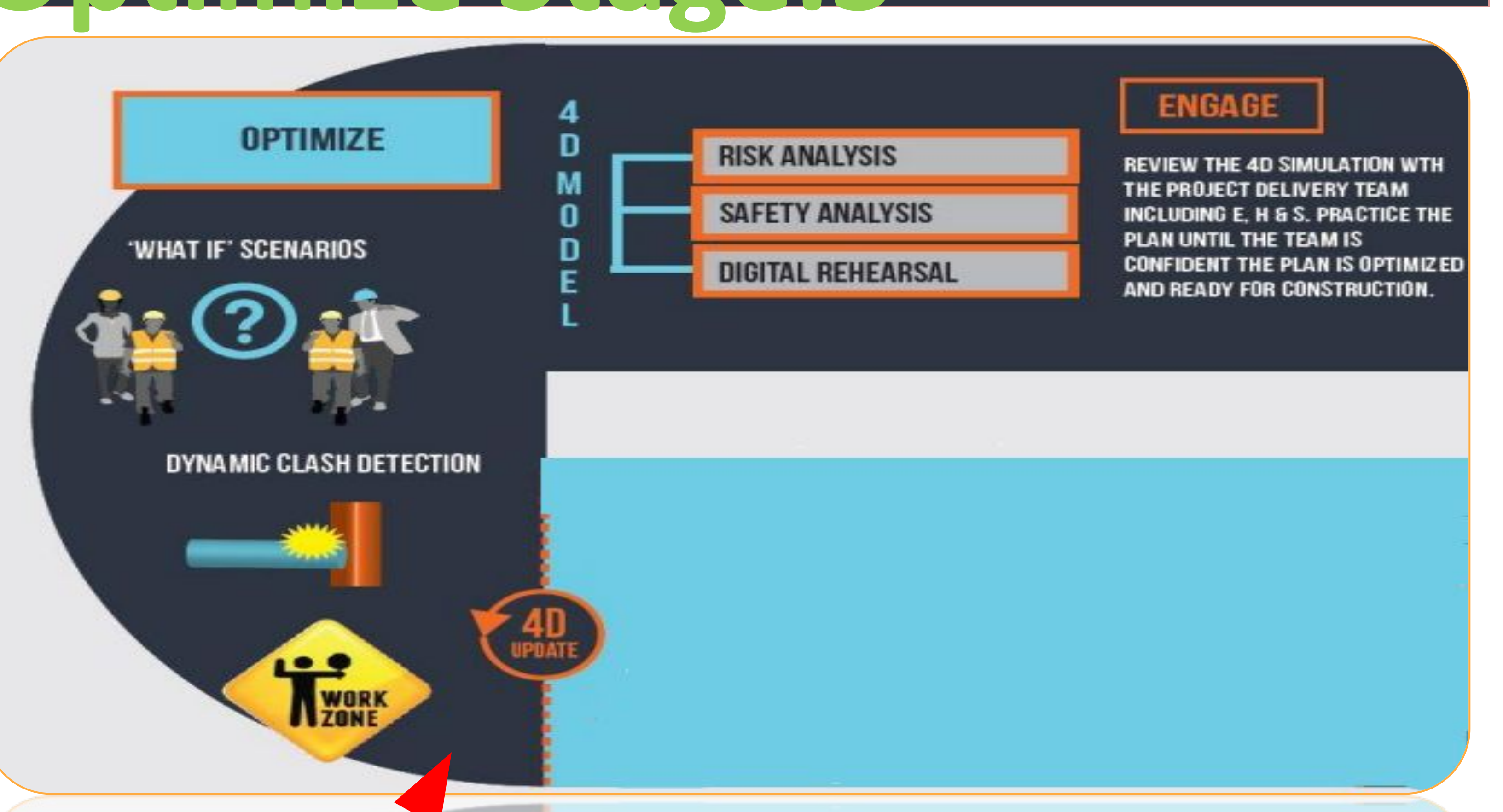
Dubai Arena

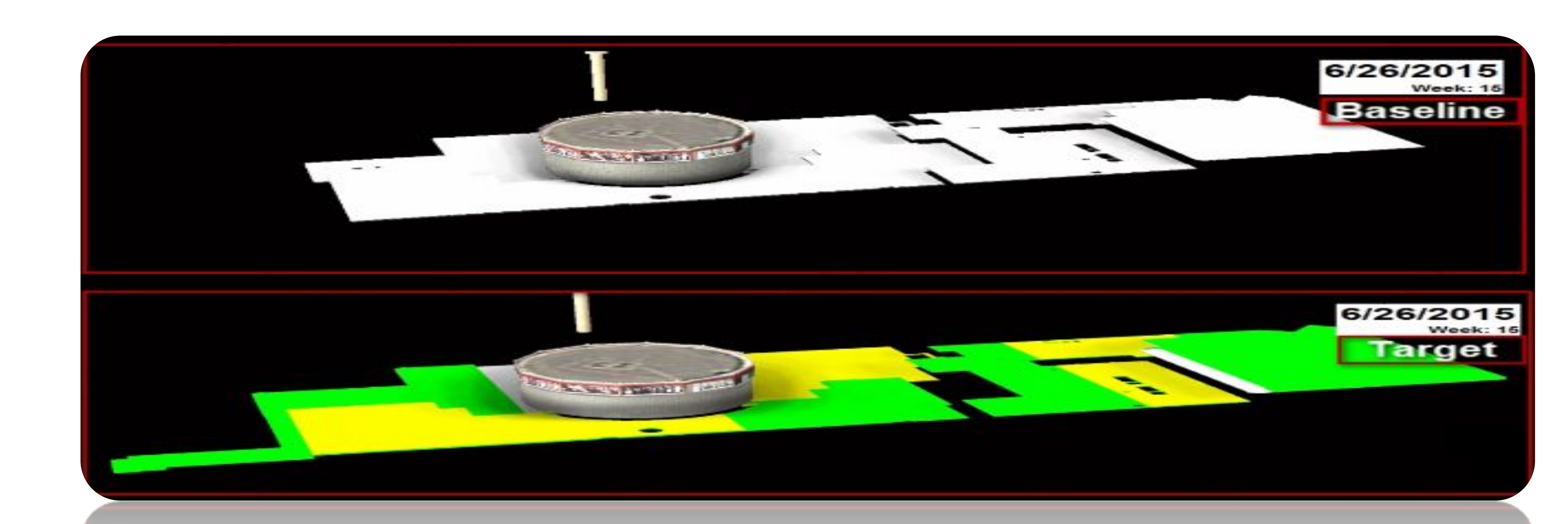
4D ROADMAP THROUGH THE PROJECT LIFECYCLE





Optimize Stage.3





Crane and safety analysis

Value engineering / What if scenarios

Reduce schedule mistakes

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Optimize Stage : Baseline Vs Target schedule.3

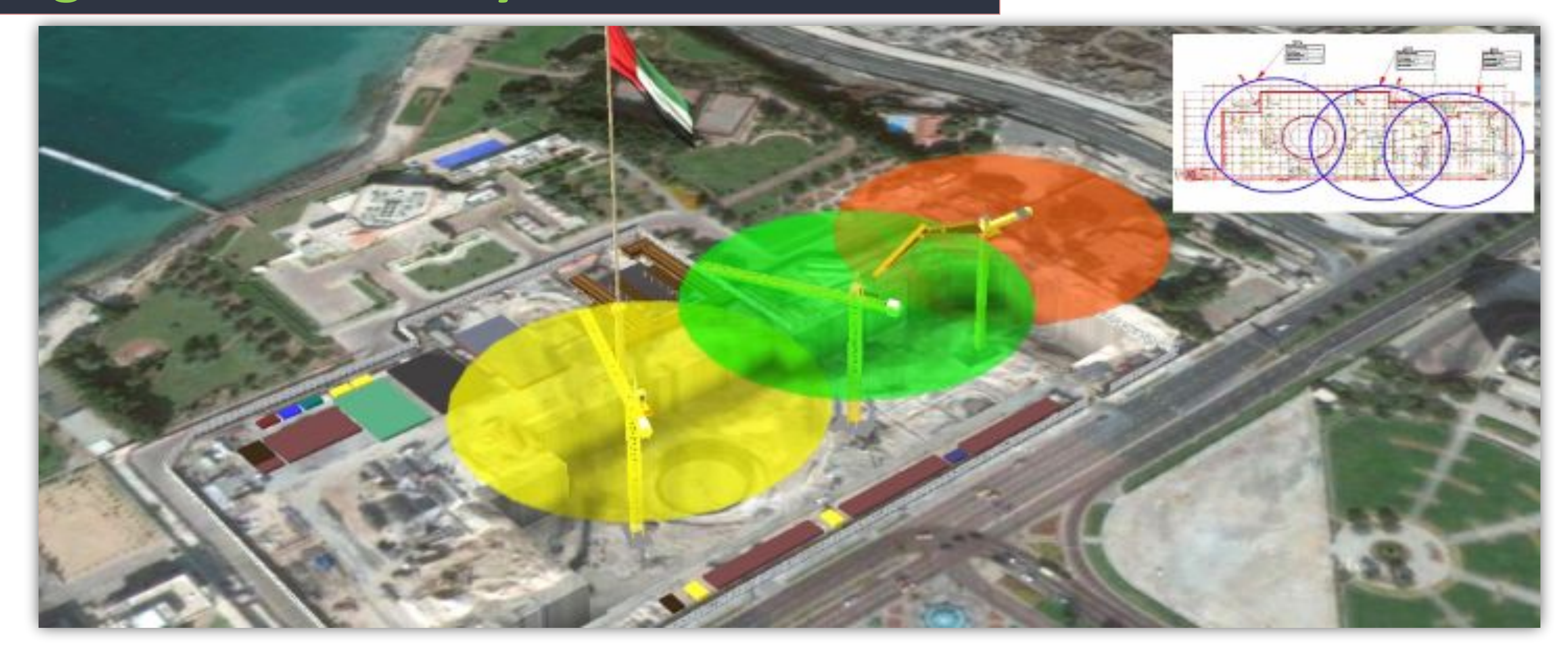
6/26/2015
Week: 16
Baseline

6/26/2015
Week: 16
Target

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Optimize Stage : Cranes Study.3



4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage.4

CONSTRUCT

LOOK AHEAD MEETINGS

4D VIEWPOINT REPORTS

4D UPDATE

PROGRESS TRACKING IN THE FIELD

COMPARE PLANNED TO ACTUAL

Compare planned to actual

Look ahead simulation

Support site team

Disputes and time analysis

2016-02-02
Week: 8

Engineering

Construction

Procurment

Verticals

Ground Floor

Engineering in progrees
Construction in progress
Procurment in progress
Completed

6/8/2015

Actual

Baseline

Concrete Structure Part 3

Concrete Structure Part 4

Slab on Grade

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage : Baseline Vs Actual.4

Baseline Vs Actual
Musuem part 1 +Part 2 + Ramp

5/27/2015
Week: 10

Baseline

5/27/2015
Week: 10

Update

	Basline	Update
Plain Concrete PCC Part 1		
Waterproofing Part 1		
Raft PArt 1		
Substructure Vertical Part 1		
Ground Floor Slab Part 1		
Plain Concrete PCC Part 2		
Waterproofing Part 2		
Raft Part 2		
Vertical Elements Part 2		
Ground Floor Slab Part 2		
SOG Part 2		
Ramp Sub. Ver. Elements		
Ramp Slab		

Verticals Casting
Slab Casting
Foundations Waterproofing
Pc casting

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage : Baseline Vs Actual.4

ASGC

Dubai Arena Project
Baseline Vs Update 4D simulation

Dubai Parks AND RESORTS

MERAAS DEVELOPMENT

dar

31/05/17
Week: 39

Baseline

31/05/17
Week: 39

Update

Mobilization	Enabling Works	Retaining Wall	Steel Main Girders	Secondary Beams -Intermediate	Rigging Gantry & Platform	Landscape Works
RC slab casting	Vertical Elements	Bleachers	Finishing	Secondary Beams -Cantilever	Facade Steel Structure	Infrastructure Works
Core Walls	Steel erection Zone 1	Staircase	MEP	Peripheral Wall	Roof Top Cover	Peripheral Wall

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage : Typical floor finishing works cycle.4

2016-02-02
Week: 8

General Block Work Phase 1
General Con of RCC Posts
General High Level MEP Works
Facade | Balcony Handrail ; 1st Fix

General Water Supply System Phase 2
General Bathroom Pods ; Ingress
Finishes BOH/EP Area Paint 1st Coat
General Fire Fighting System Phase 2

General HVAC System ; Phase 2
BOH & MEP ; Paint Up to 1st Coat
General | Bathroom Pods Installations
General Areas | Door Sub Frames

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage : Engineering , Procurement and construction simulation.4

Engineering

Construction

Procurment

PCC

Waterproofing

Raft

Verticals

Ground Floor

Engineering in progrees

Construction in progress

Procurment in progress

Completed

Apr May Jun Jul Aug Sep Oct Nov Dec Jan 2016 Feb Mar Apr May Jun Jul Aug Sep

wk 3 wk 8 wk 12 wk 16 wk 21 wk 25 wk 29 wk 34 wk 38 wk 43 wk 47 wk 51 wk 56 wk 60 wk 64 wk 69 wk 73 wk 77

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Construct Stage : Walkthrough.4

4D ROADMAP THROUGH THE PROJECT LIFECYCLE



Lessons Learned Stage.5



As-Built Documentation

Dispute Resolution

Operations and Maintenance

4D MODELING OVERALL BENEFITS



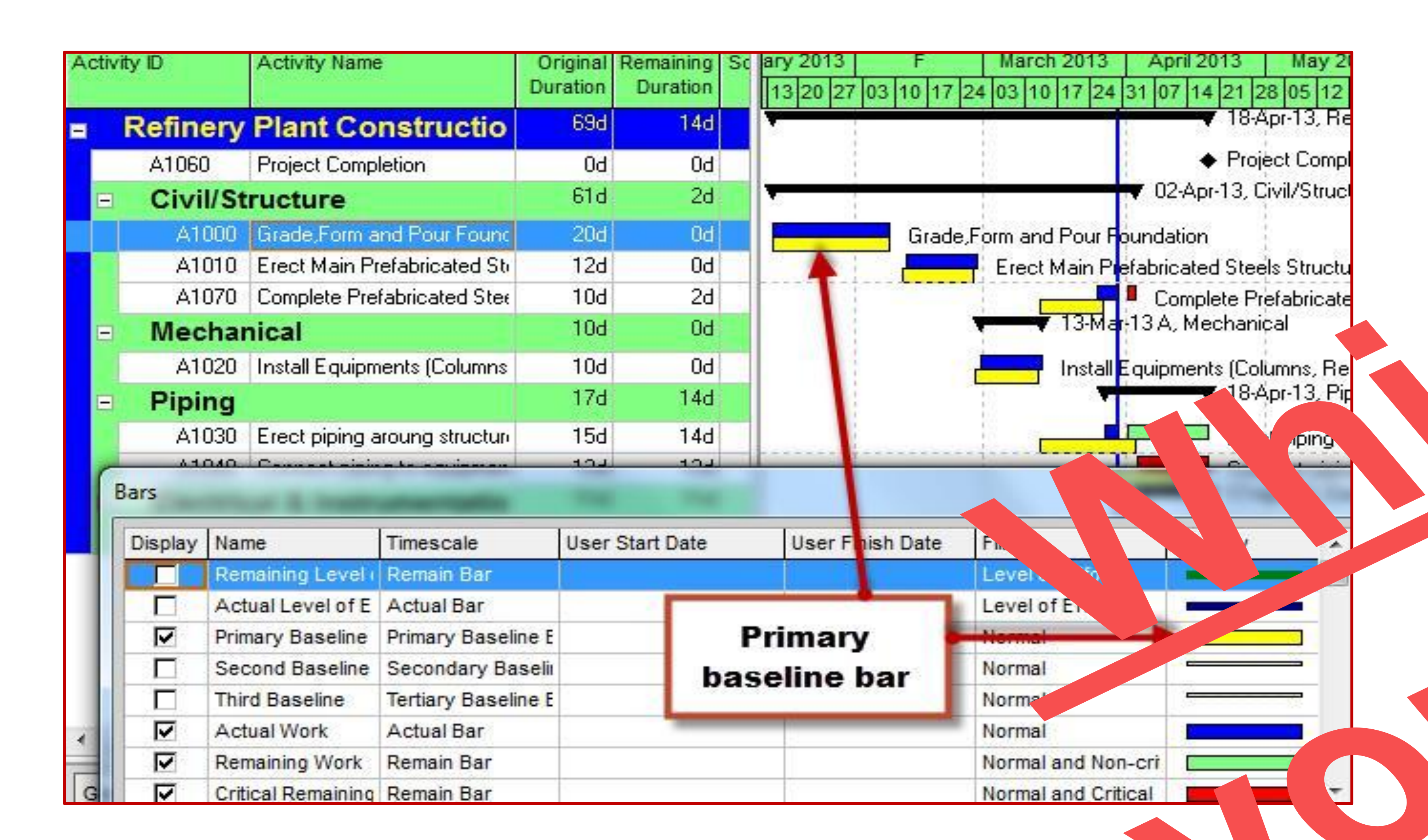
Which do you prefer ???

Traditional Planning and scheduling

4D Planning and scheduling

4D MODELING OVERALL BENEFITS







Which do you prefer ???

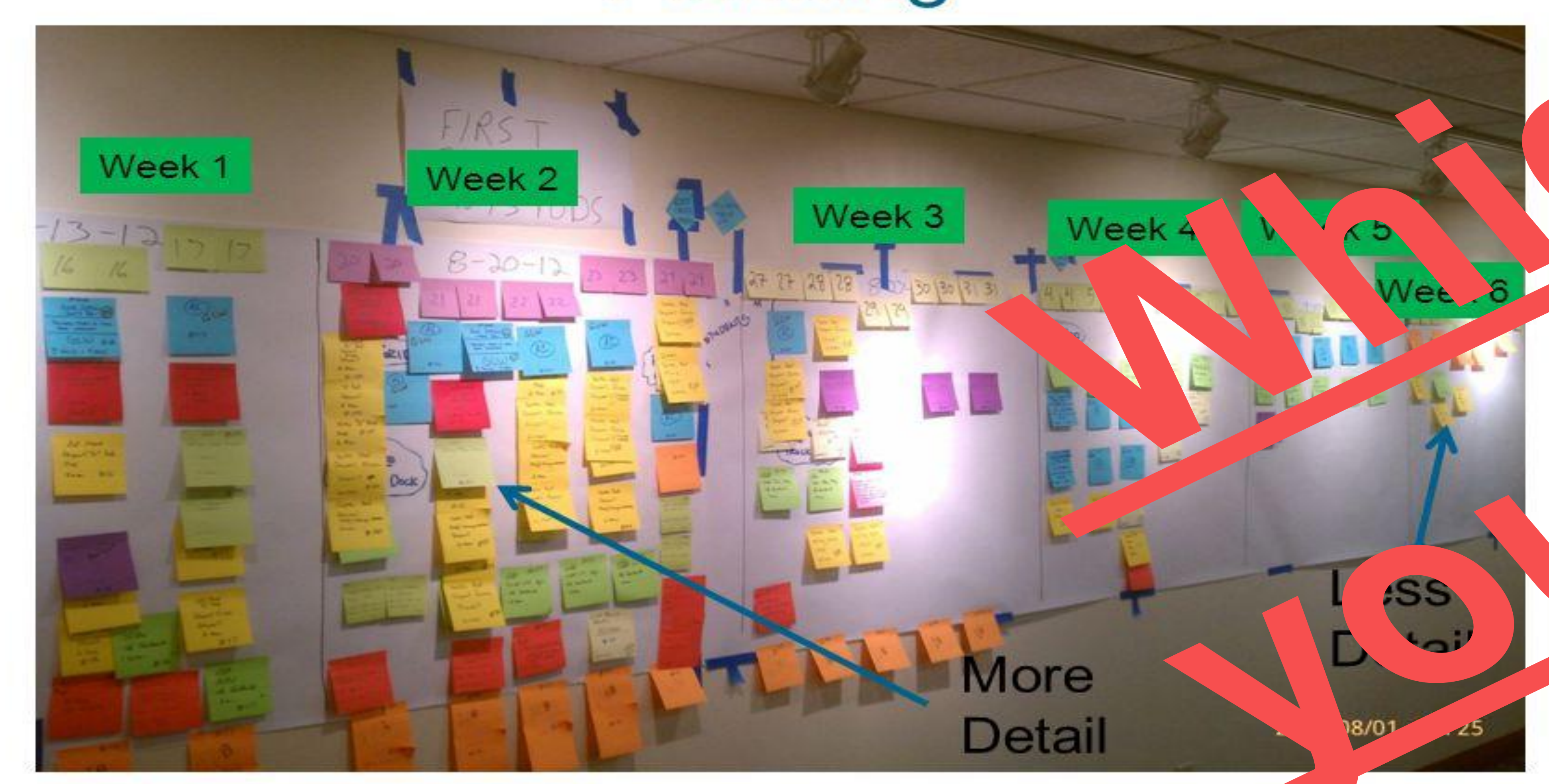
Traditional Baseline Vs Actual

4D Baseline Vs Actual

4D MODELING OVERALL BENEFITS



Six-week Look-ahead/Make-ready Planning



Traditional Lookahead



4D Lookahead



4D MODELING OVERALL BENEFITS

Which do you prefer ???

Traditional Progress meeting discussion

4D Progress meeting discussion

4D MODELING OVERALL BENEFITS



Which do you prefer ???

As-Planned Schedule

As-Planned versus As-Built Comparative 4D Model

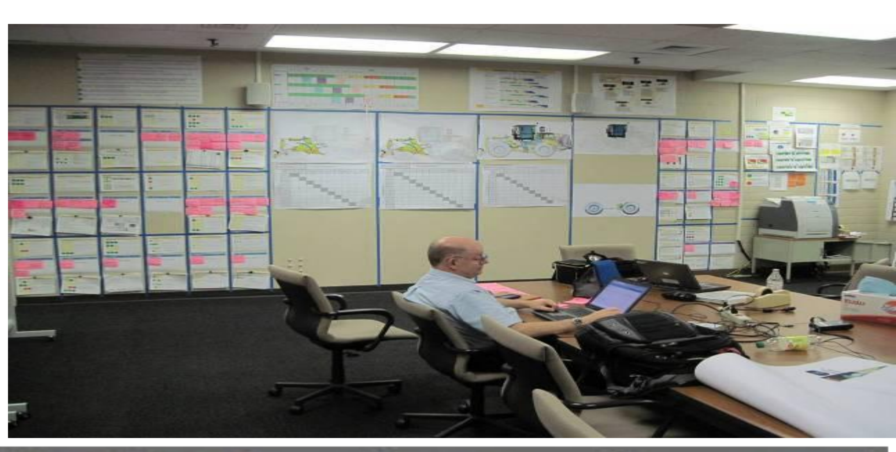
Updated Schedule impacted

Traditional Claim analysis

4D Claim analysis

4D MODELING OVERALL BENEFITS

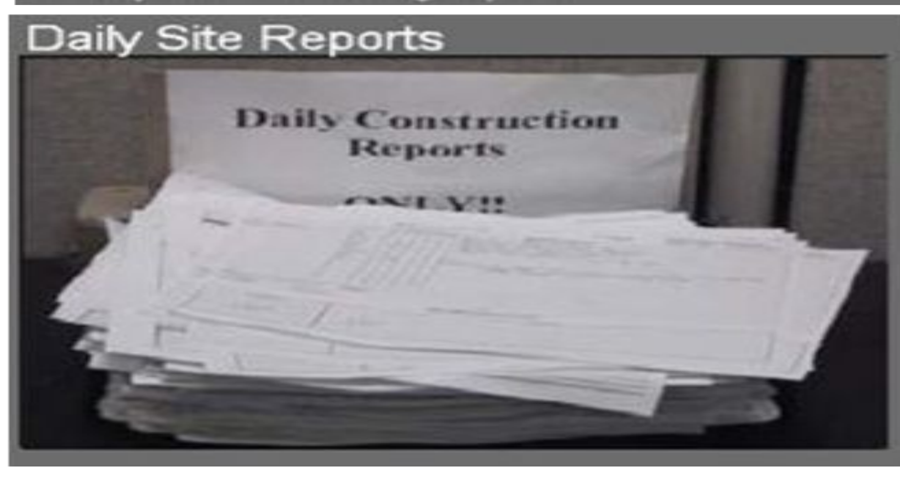


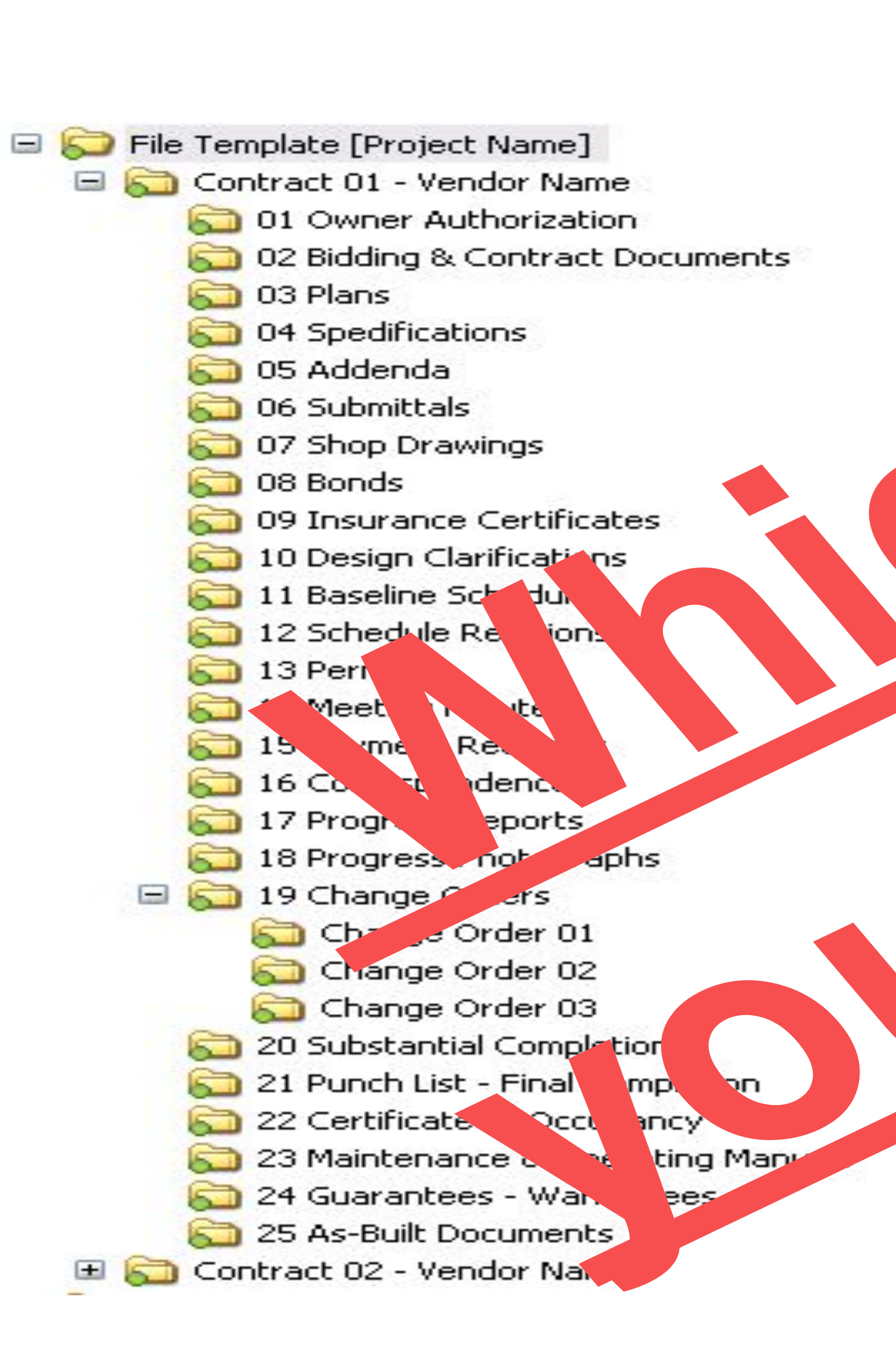




Daily Site Photographs

Daily Site Reports





Which do you prefer ???



Traditional Documentation

4D Documentation


BIMarabia
Academy





So, a BIM model can be made up of multiple 3d objects, to create a 3d model , these can be interlinked with activities from a Gantt chart and costs for permanent and consumable resources can be applied.



As planned

As Built

Critical delay to columns construction

Software



Product Name	Manufacturer	BIM use
Synchro	Synchro LTD	Planning and scheduling
Navisworks Manage	Autodesk	Clash detection
Projectwise	Bently	Clash detection
Digital project designer	Gehry Technologies	Model coordination
Visual Simulation	Innovaya	scheduling
Solibri Model checker	Solibri	Spatial Coordination
Tekla Structures	Tekla	Structure-centric Model
Vico office	Vico software	Scheduling Estimating

Synchro



the most powerful tool in the market for the 4D simulation and schedule analysis but with good rendering output , visual clash detection only and fair EVA capabilities.

Navisworks



Powerful in Quantity take-of and clash detection with good 4D capabilities and good rendering output.



	Navisworks Manage	Navisworks Simulate	Navisworks Freedom
Project viewing	✓	✓	✓
Project review	✓	✓	✗
Combine files	✓	✓	✗
Sequence simulation	✓	✓	✗
Animations	✓	✓	✗
Visualization	✓	✓	✗
Clash detection	✓	✗	✗
Interference Management	✓	✗	✗
Coordination	✓	✗	✗

Table 1 – Key diversities of Navisworks products

Bentley Navigator



Powerful in Quantity take-of and clash detection with poor 4D simulation capabilities and poor rendering output .



Vico



is recommended for projects with repeated activities (for example pipe laying activities) , since it depends on flow line techniques based on location.



very powerful in 5D simulation and quantity take of with low 4D simulation capabilities and good clash detection reports.



zBuilder

Engineering Systems Bim Viewer System

Online Viewer



Resource Plan



Project Elements	Activities	Quantity of work	Plant Resources	Labour Resources	Estimated Duration
Win/S					
Mobil					
Set-u					

Project Elements	Activities	Quantity of work	Plant Resources	Labour Resources	Estimated Duration
Substructure					

Activity	Name	Duration	Predecessor
1	Contract documentation	2 wks	-
2	Move tools and Equipments	0.5 wk	4
3	Move materials	0.5 wk	4
4	Obtain permit	4 wks	1
5	Erect temporary fence	0.5wk	2
6	Erect Storage	0.25 wk	4
7	Clear/ Prepare Lot	1.5 wks	4
8	Mark-out footprint	1 wk	10
9	Demolish existing fibro & other structures and remove	1 wk	7
10	Remove asbestos	4 wks	7
11	Obtain approval	0.2 wk	8
12	Excavate bulk, trenches for strip and ground beams, and pads	1 wk	11
13	Remove surplus materials	1 wk	12
14	Prepare & support surface of excavation	1 wk	12
15	Obtain permit	0.2 wk	14



Critical Path (General Principles)

- Projects are comprised of activities or tasks
- Activities require/consume resources
- Resources include

– Labour
– Plant
– Materials
– Finance
– Time

- Activities generally need to be completed in a sequence

- If one person was able to complete the project on their own then the tasks would be completed just a sequence, one after the other

- If multiple resources are available then they determine the logical sequence of activity completion



Critical Path (Example)

Steps

- You need to define tasks with action words
- You need to determine duration based on nature and available resources

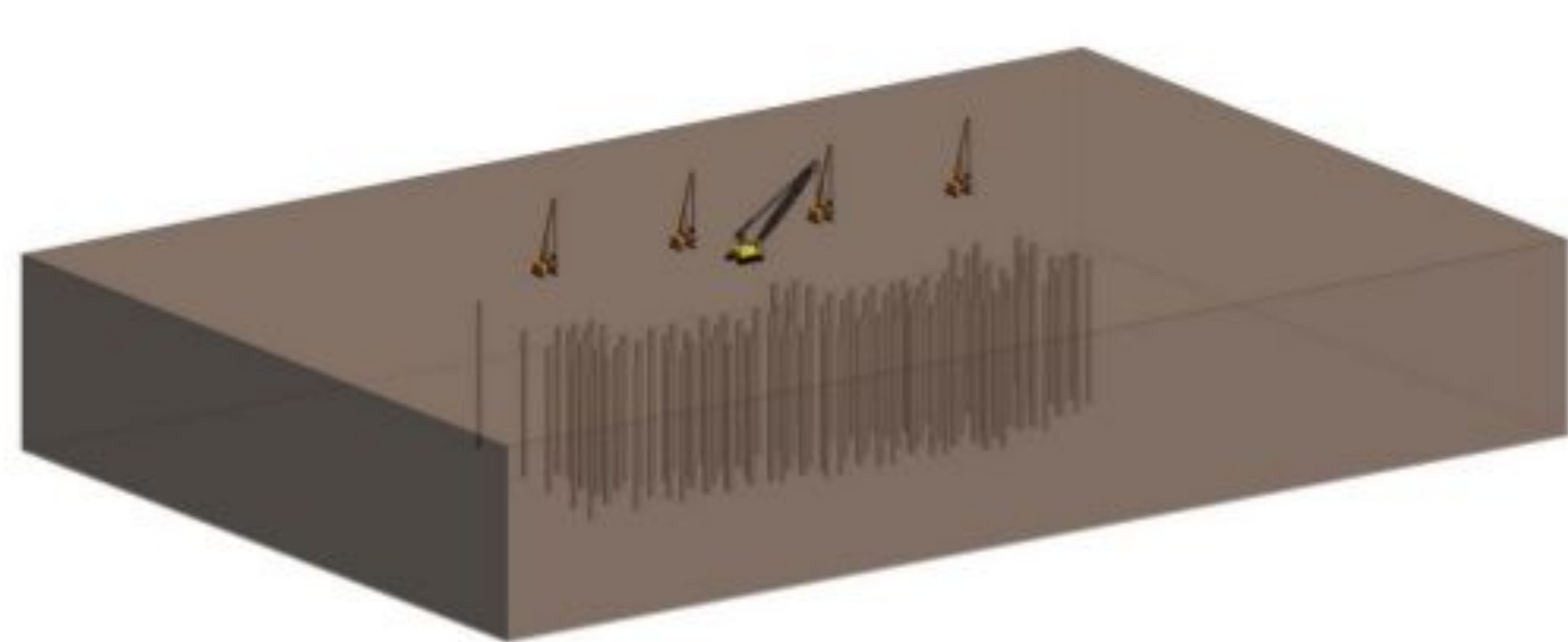
Activities on the Arrow

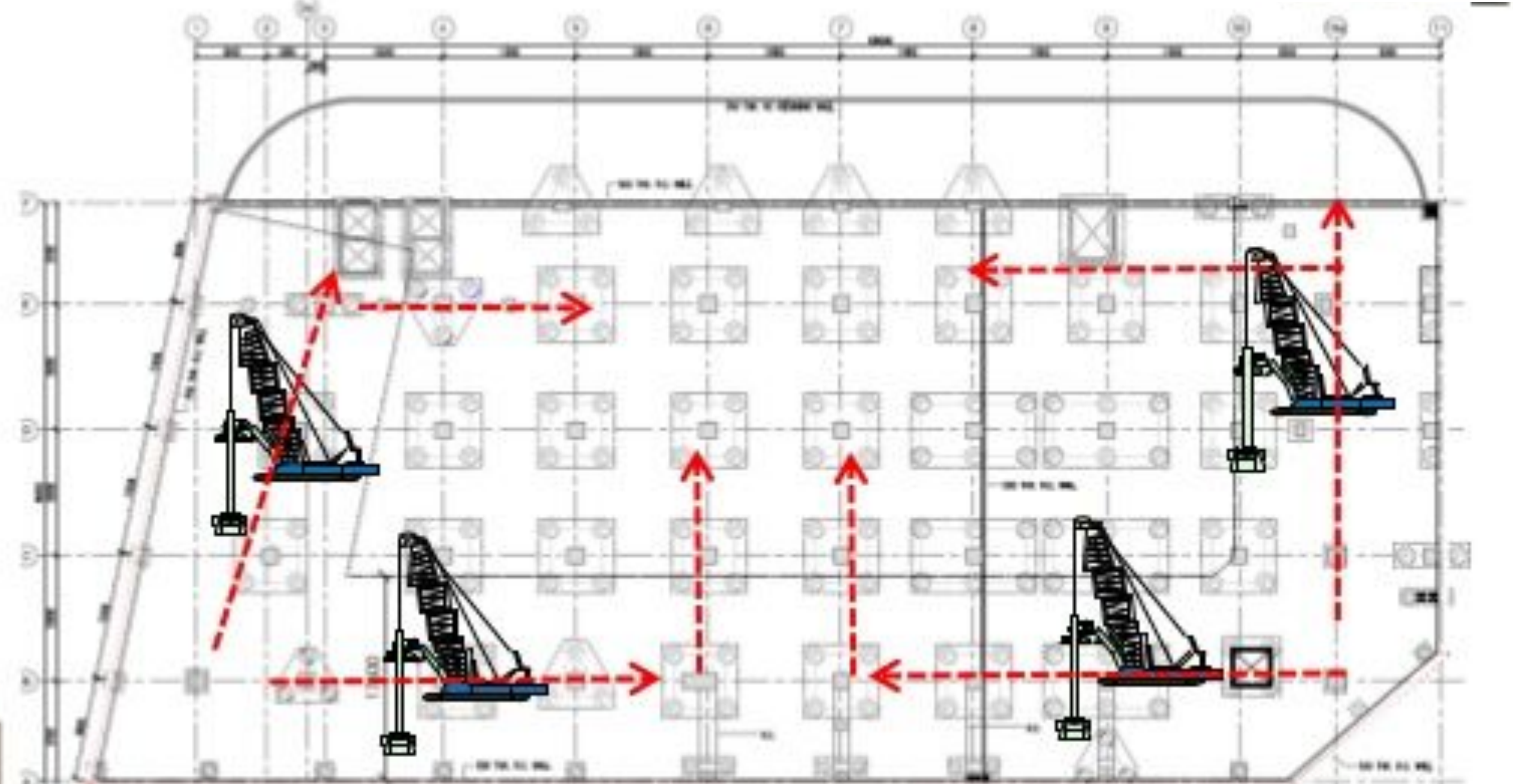
The activities, represented by arrows, can be logically arranged thus…..

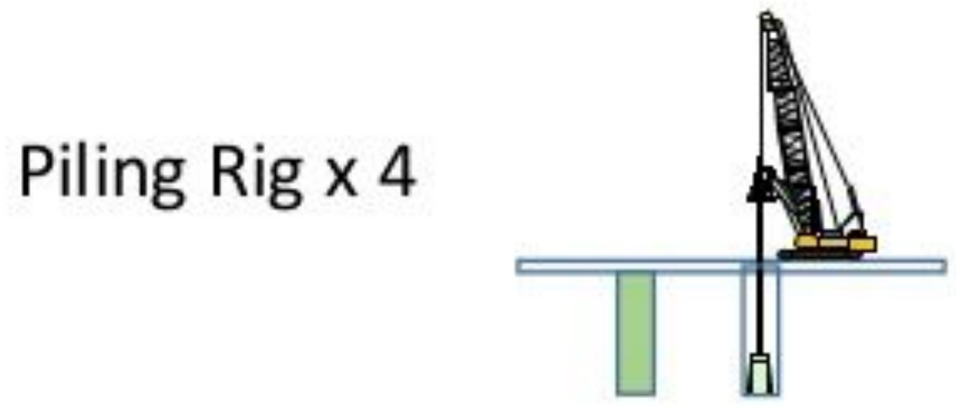
Obtain steel
Cut and bend
Set out
Excavate
Place steel
Place concrete
Obtain concrete

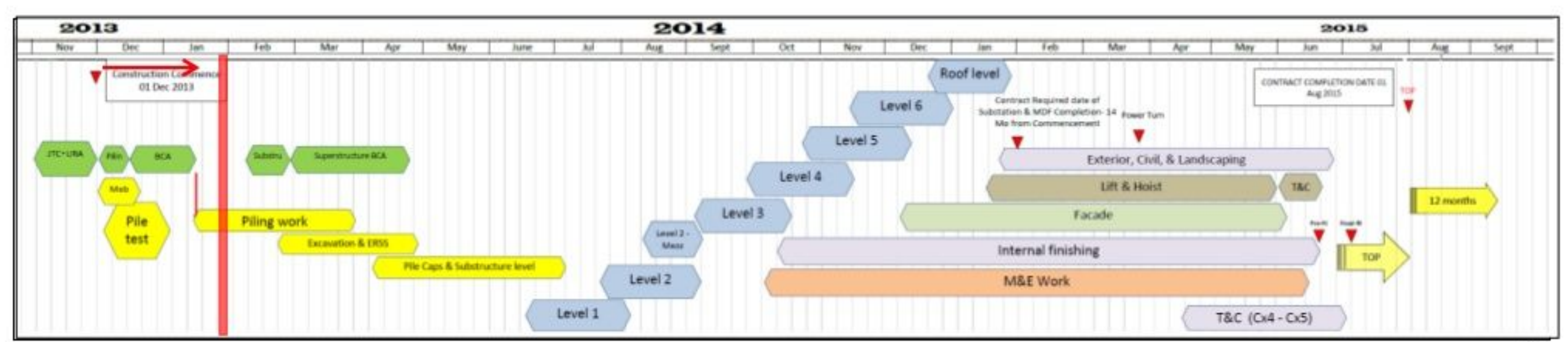
Construction Sequence & Methodology

- Site Mobilization Complete
- Test Pile Completed.
- Piling started & ongoing





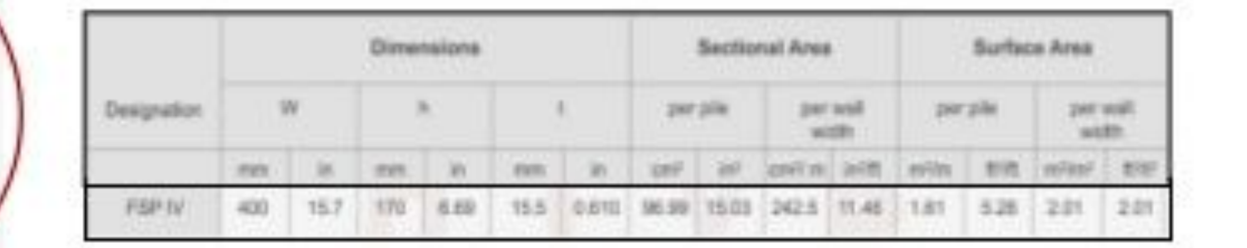




Construction Sequence & Methodology

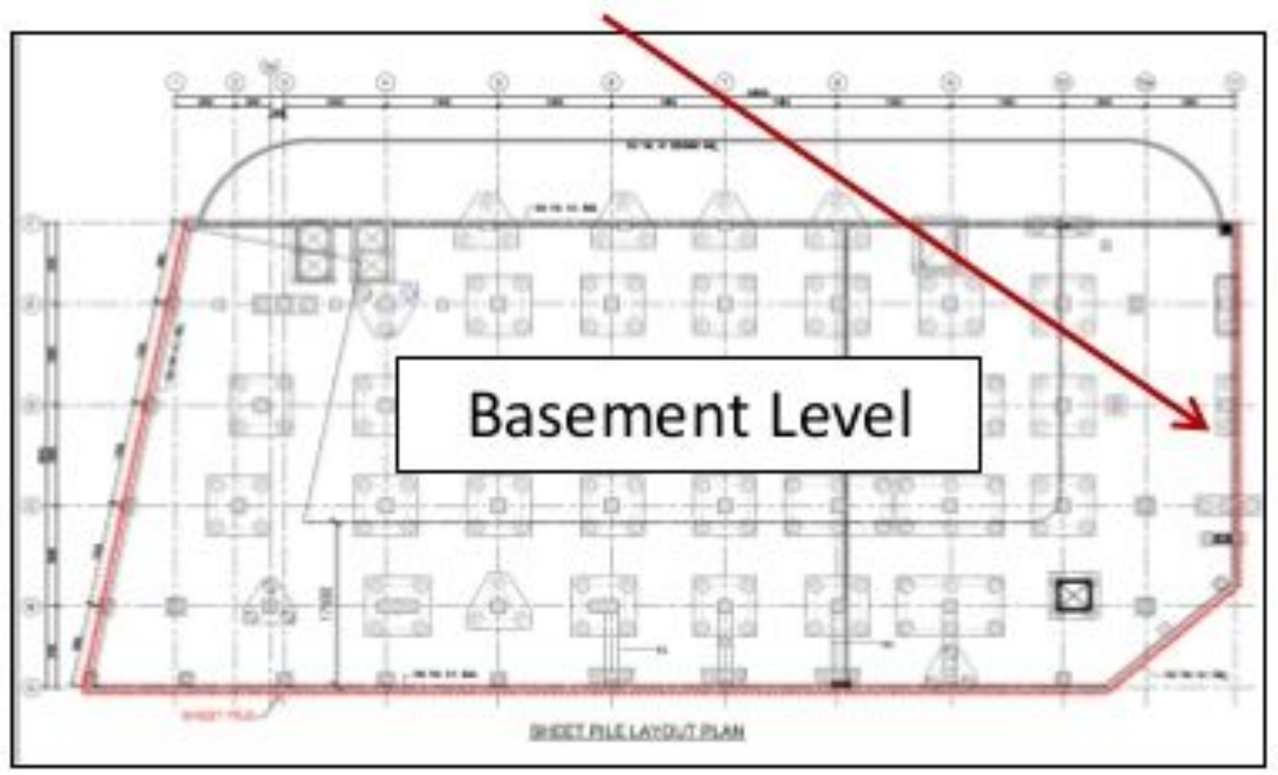


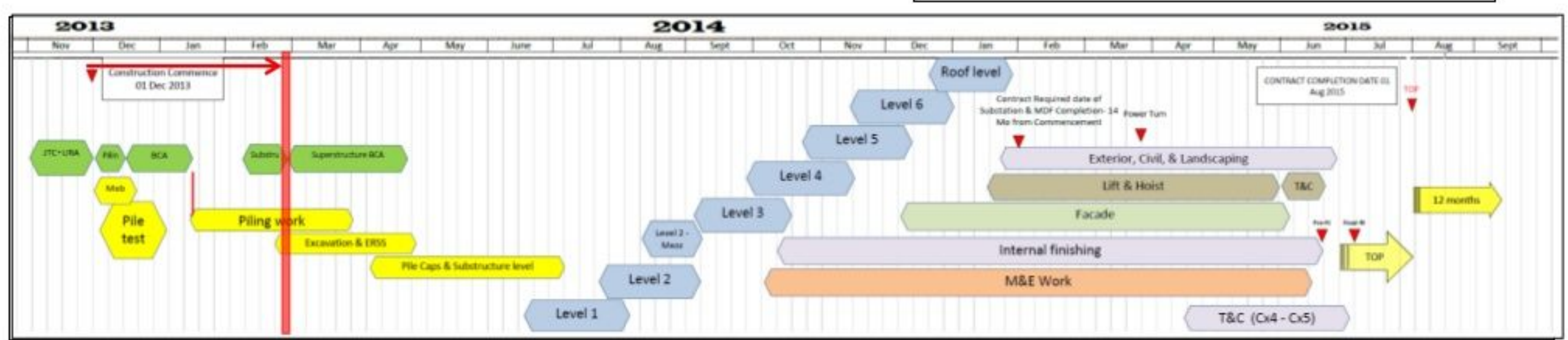
- RC Bored Pile Installation Complete
- Substructure ERSS Commence
- Sheet Pile Installation Commence



Designation	Dimensions						Sectional Area				Surface Area			
	W		h		t		per pile		per wall width		per pile		per wall width	
	mm	in	mm	in	mm	in	cm²	in²	cm²/m	in²/ft	m²/m	ft²/ft	m²/m²	ft²/ft²
FSP IV	400	15.7	170	6.69	15.5	0.610	96.99	15.03	242.5	11.46	1.61	5.28	2.01	2.01

FSP IV Sheet Pile installed to approx. 16m - 18m depth at basement wall locations along site boundary

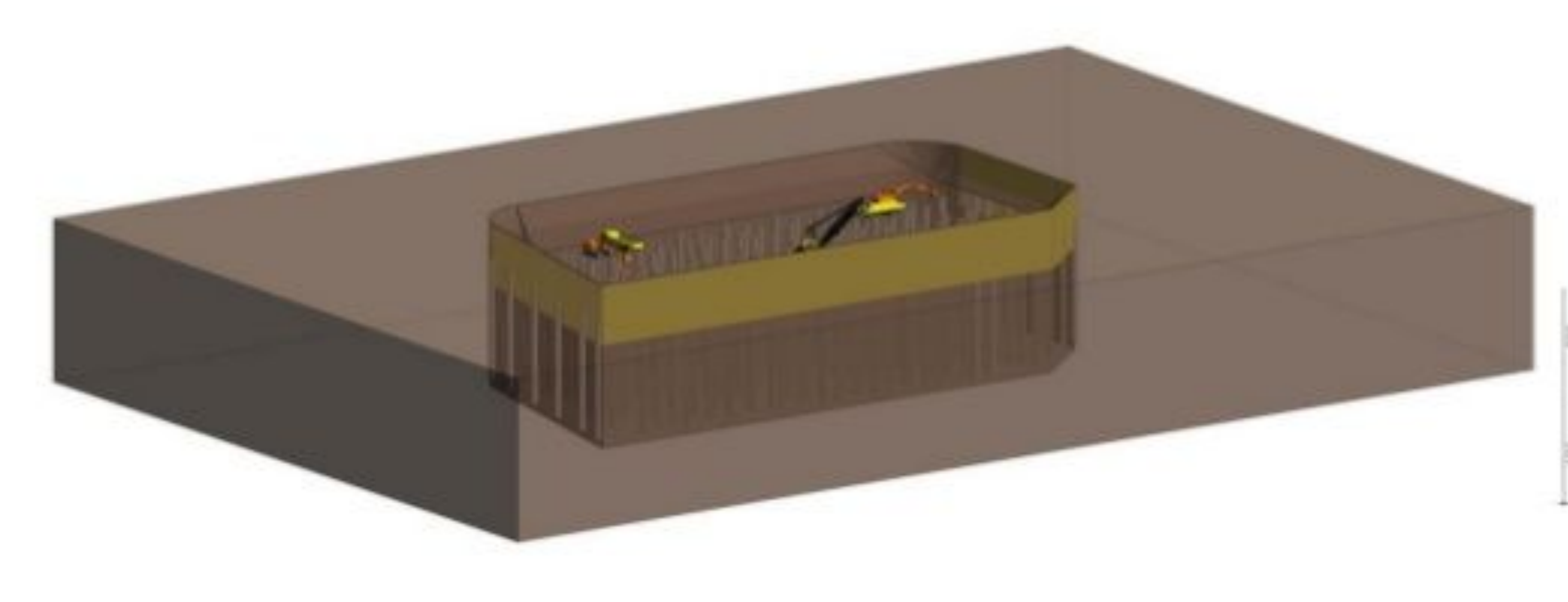


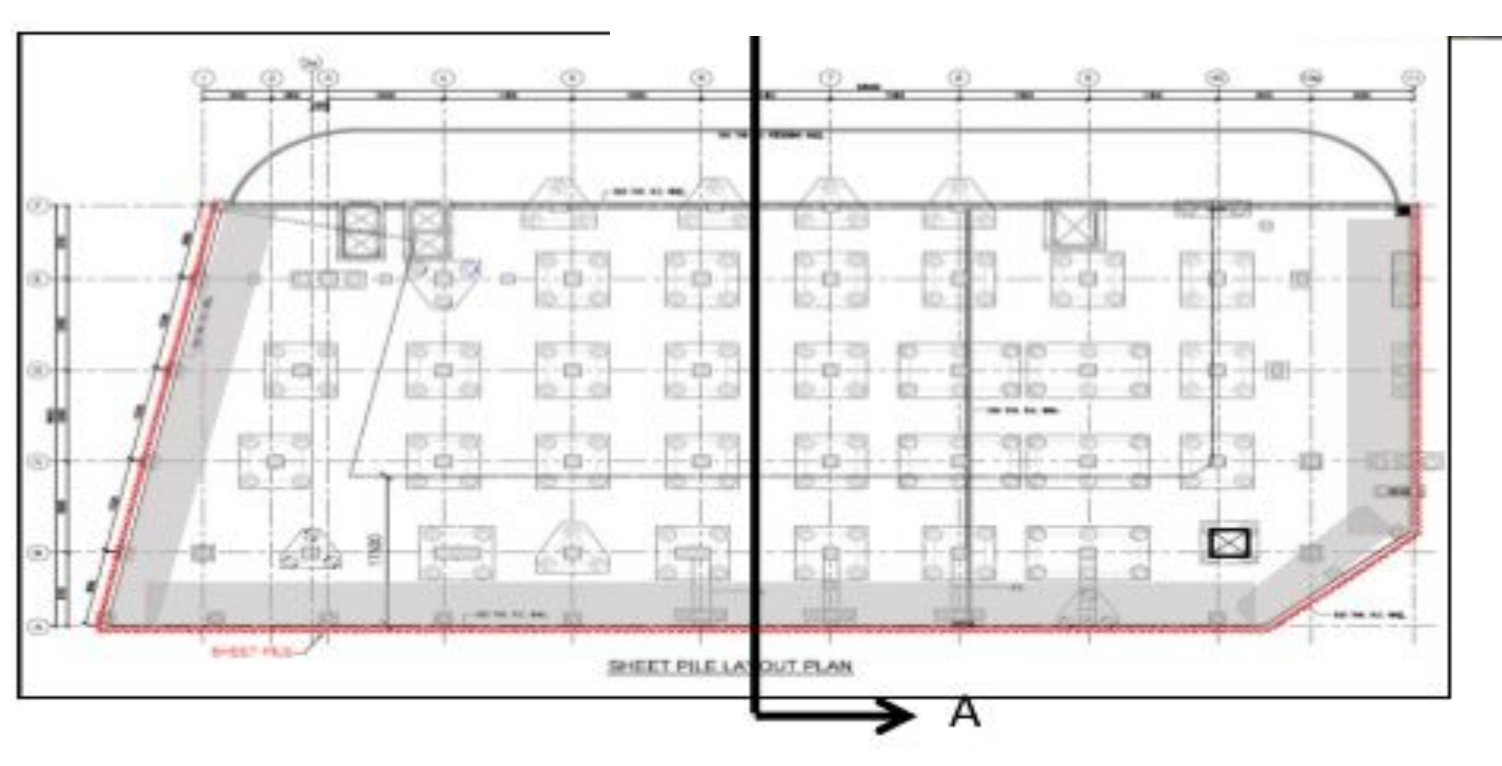


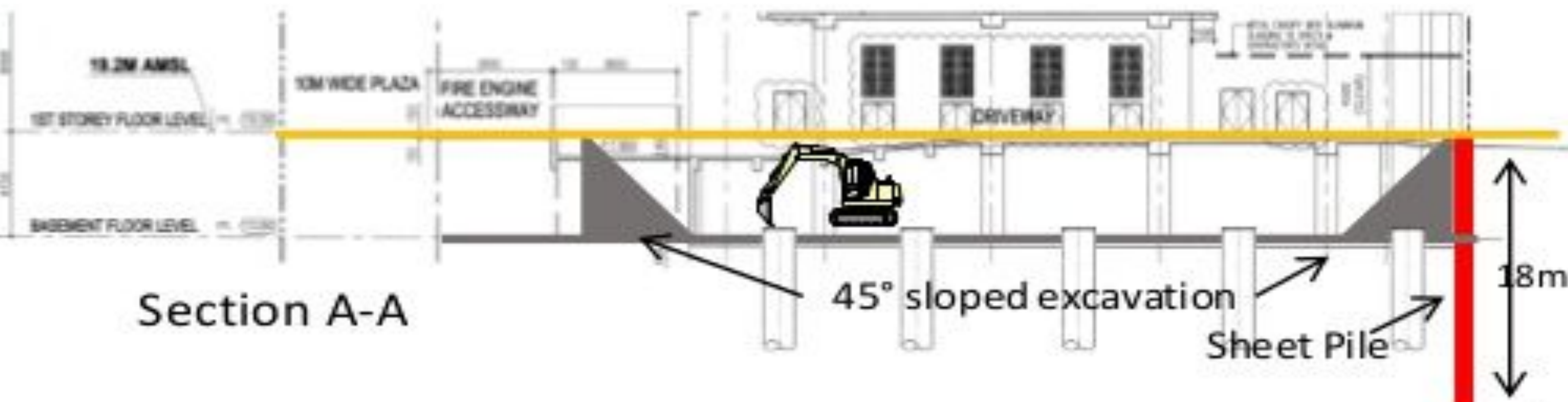


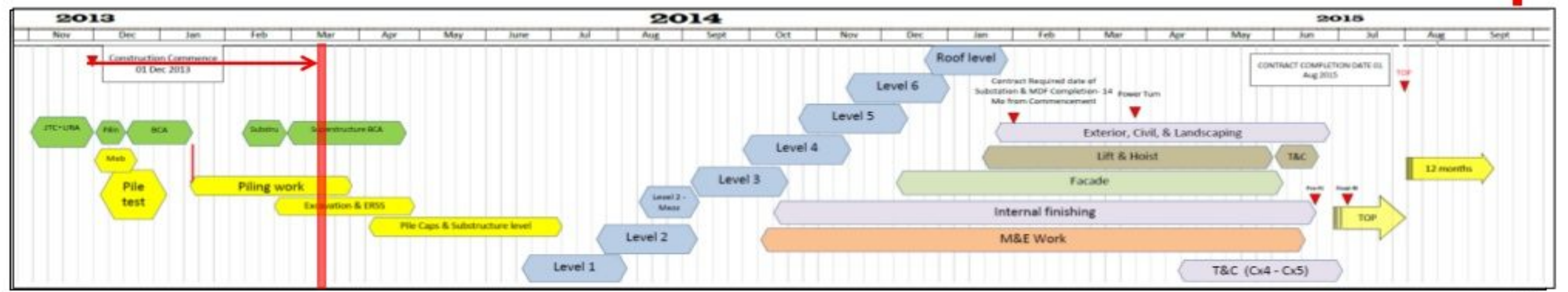
Construction Sequence & Methodology

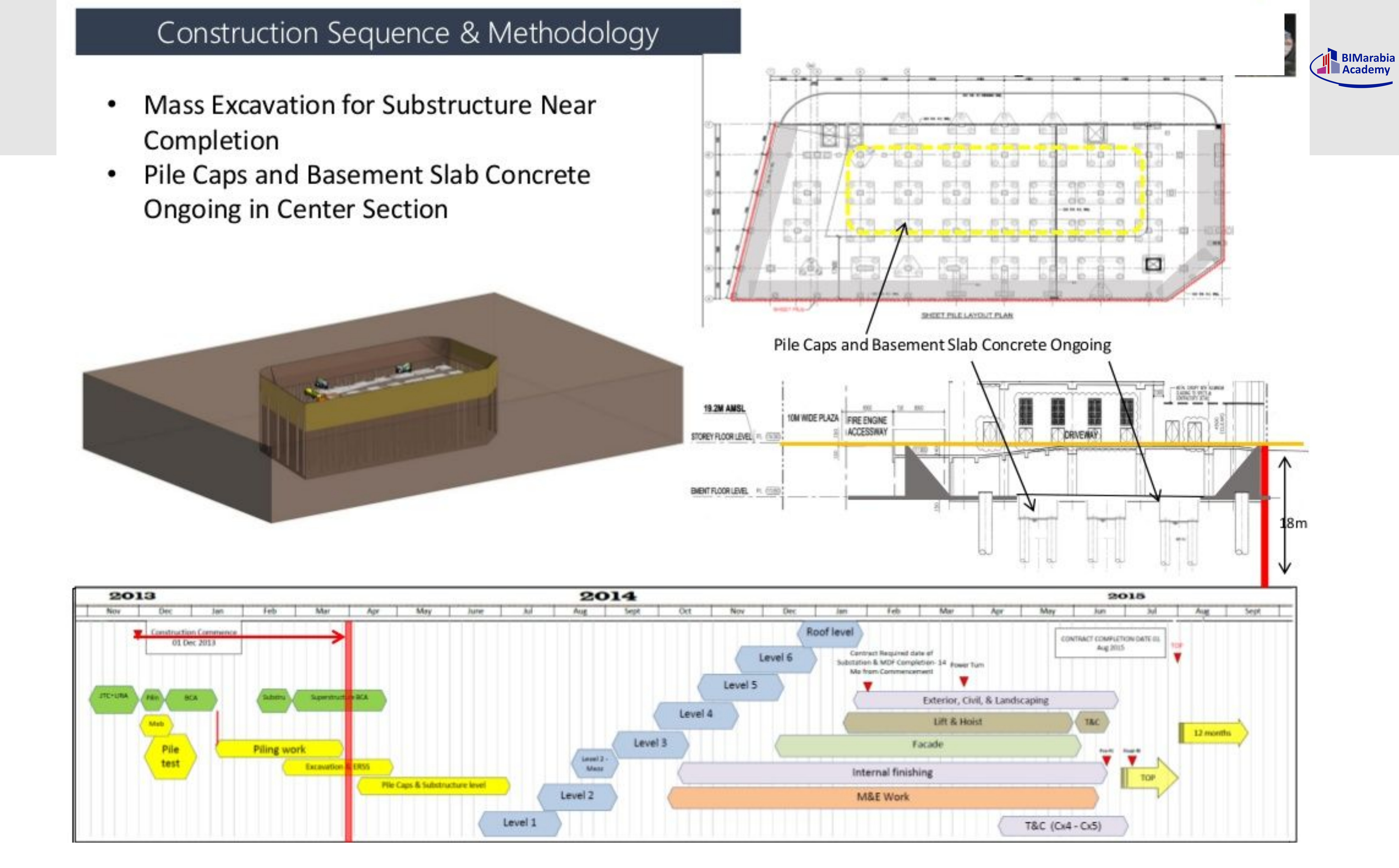
- Sheet Piling Complete
- Substructure Excavation & Pile Hacking Ongoing
- Keeping 45° sloped excavation at perimeter







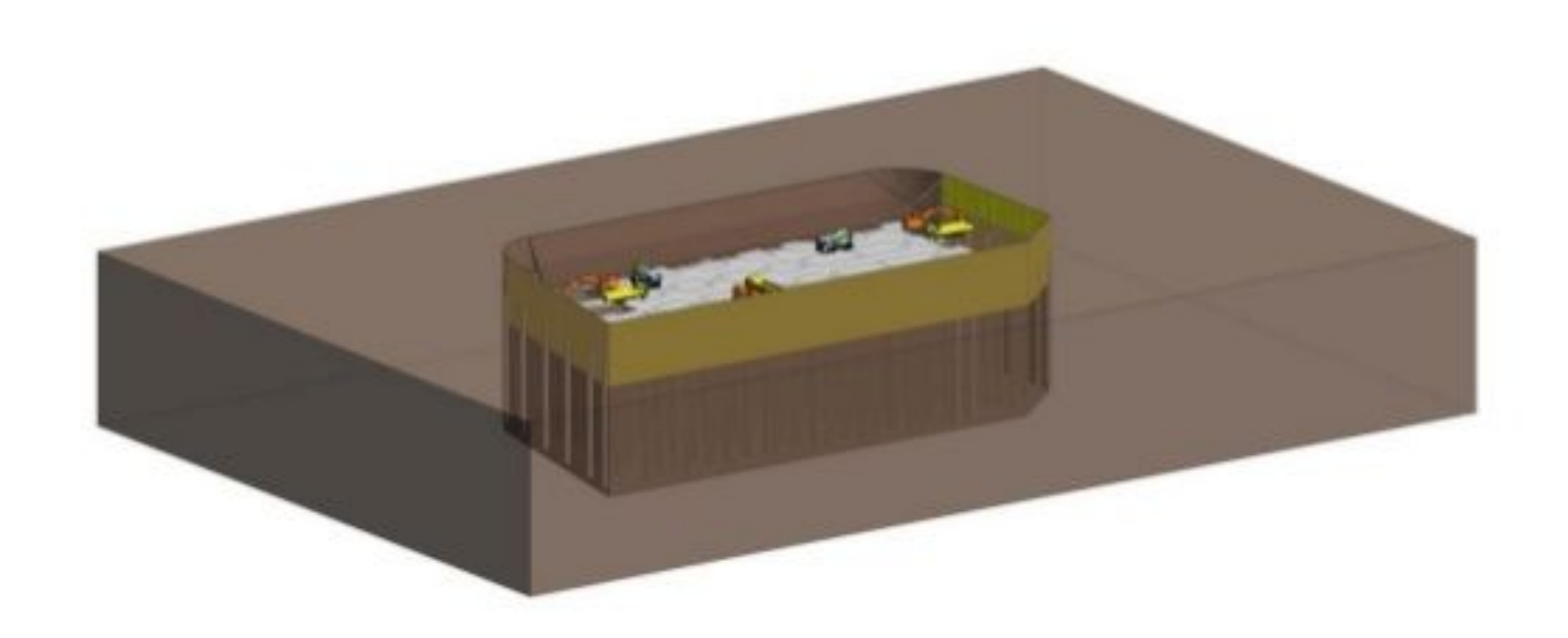


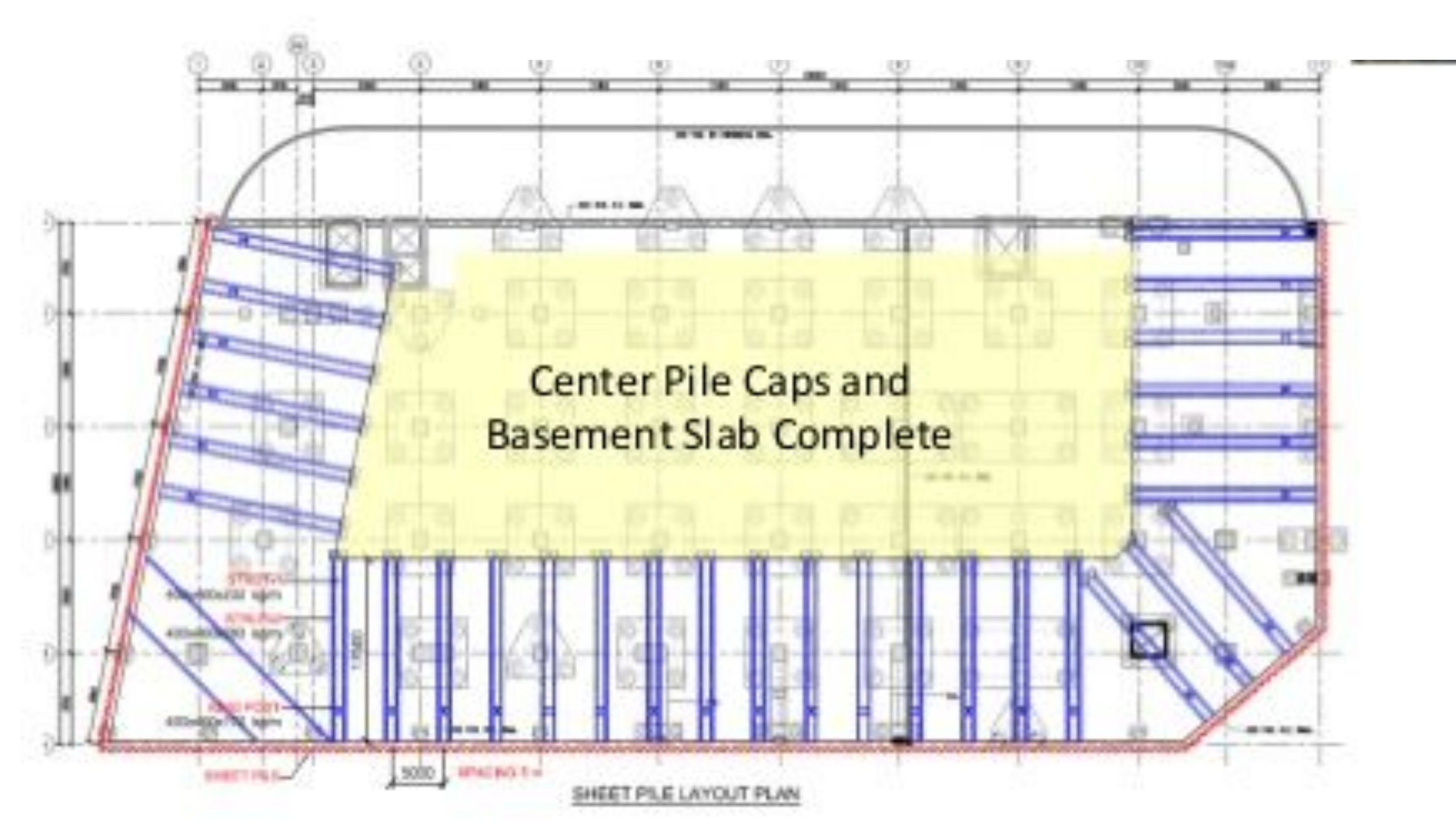

Construction Sequence & Methodology
• Mass Excavation for Substructure Near Completion
• Pile Caps and Basement Slab Concrete Ongoing in Center Section
BIMarabia Academy
SHEET PILE LAYOUT PLAN
Pile Caps and Basement Slab Concrete Ongoing
19.2M AMSL
10M WIDE PLAZA
FIRE ENGINE ACCESSWAY
DRIVEWAY
STOREY FLOOR LEVEL
BMENT FLOOR LEVEL
18m
2013
2014
2015
Nov
Dec
Jan
Feb
Mar
Apr
May
June
Jul
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Construction Commence 01 Dec 2013
Roof level
Level 6
Level 5
Level 4
Level 3
Level 2 - Mass
Level 2
Level 1
Piling work
Excavation & ERSS
Pile Caps & Substructure level
Pile test
BCA
Exterior, Civil, & Landscaping
Lift & Hoist
T&C
Facade
Internal finishing
M&E Work
T&C (Cx4 - Cx5)
12 months
TOP
Power Turn

Construction Sequence & Methodology

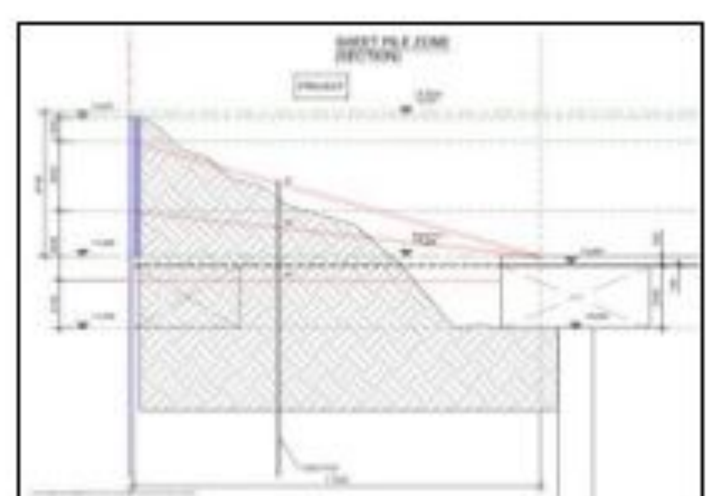
- Center Portion Pile Caps and Basement Slab Complete
- Perimeter Excavation Ongoing.
- ERSS Strut Installation at Perimeter Wall Ongoing



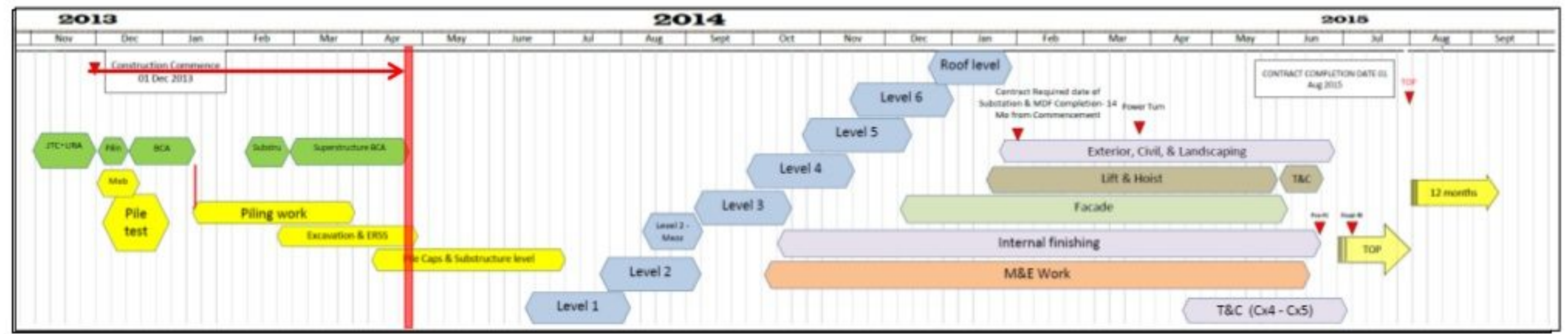




Struts installed at 5m spacing, 17.5m in length. S1, S2, & S3 + King Post

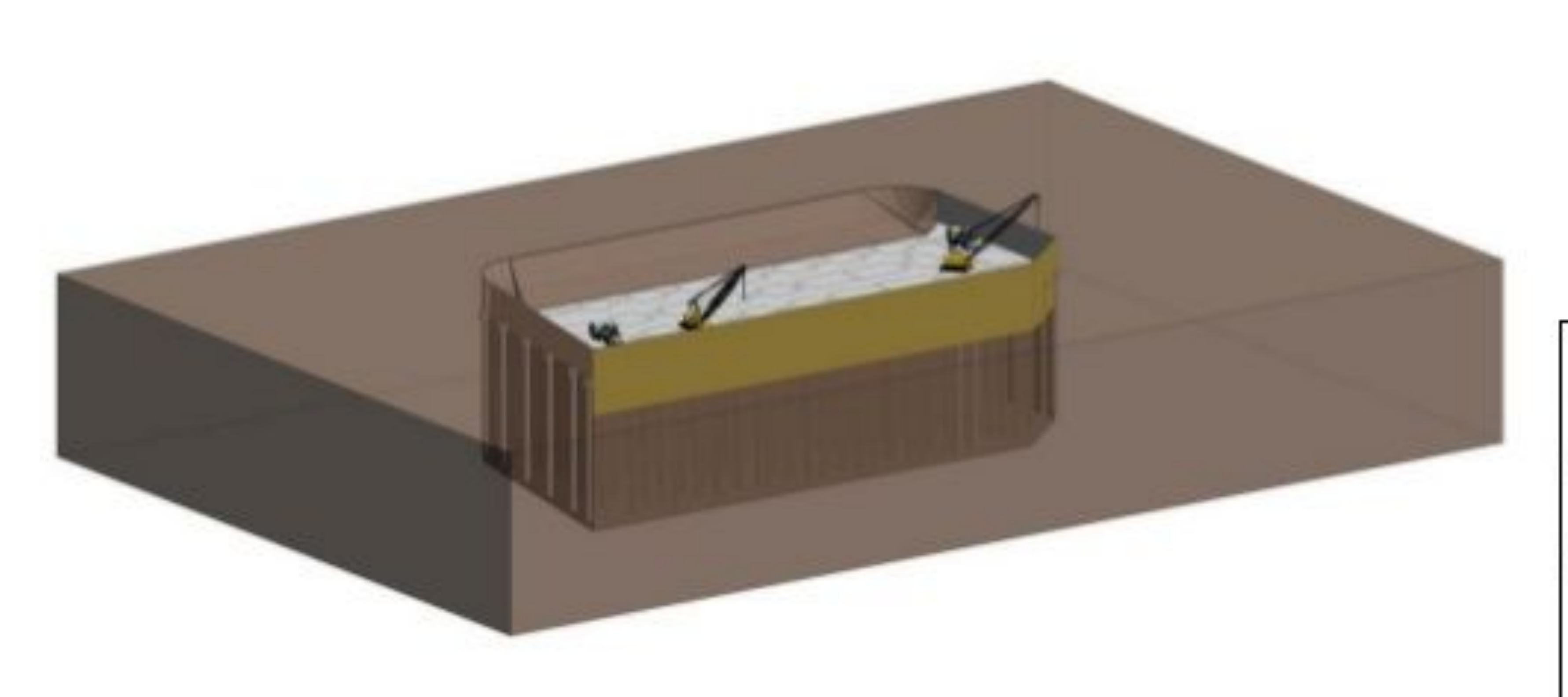


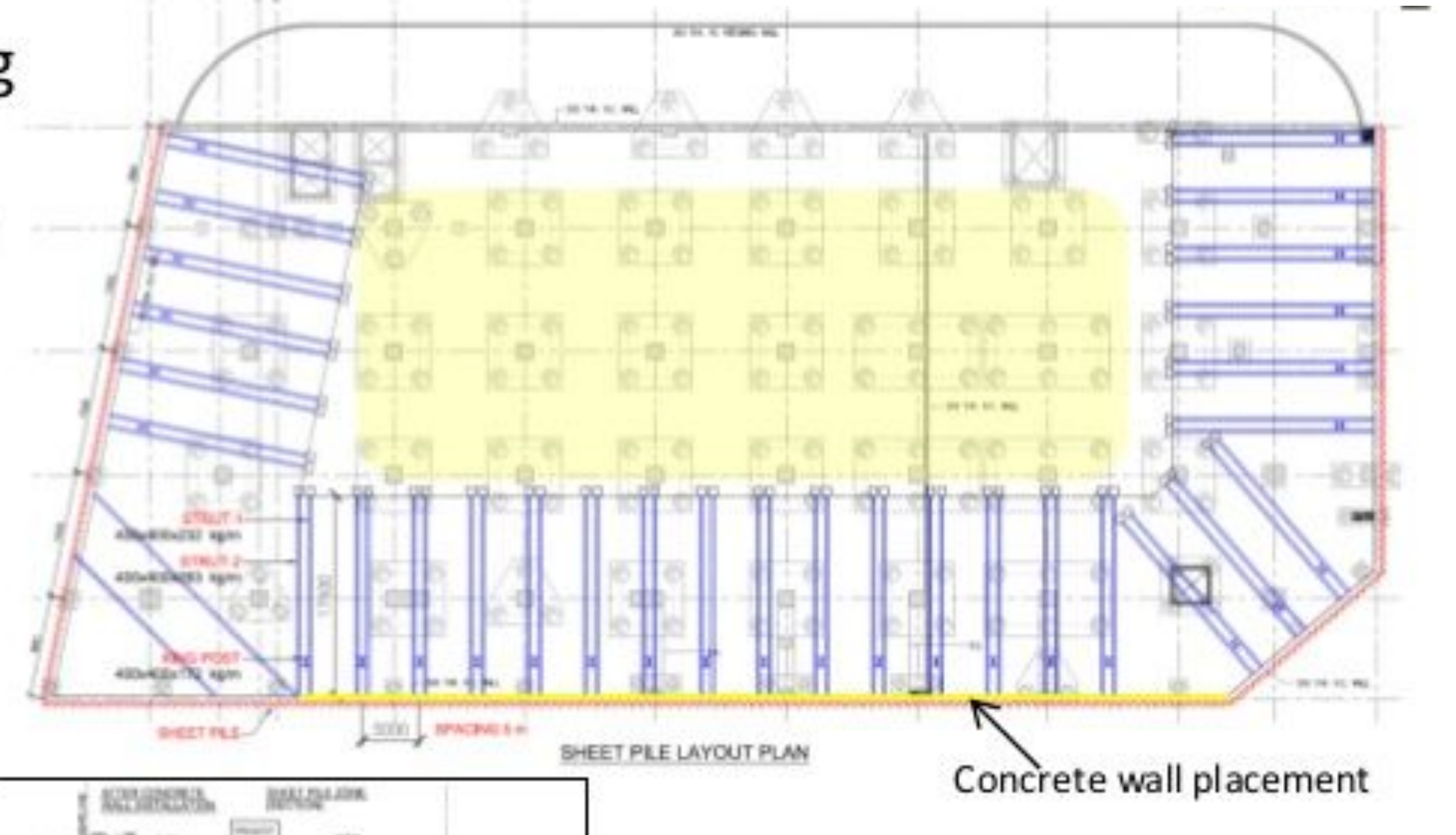
Concept Sheet Pile/Strut Detail

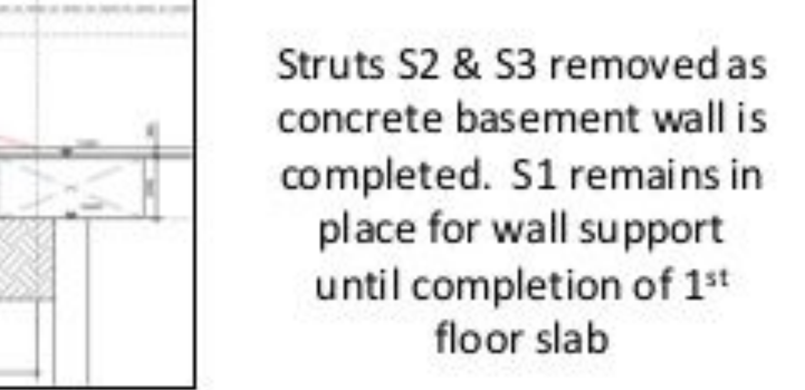


Construction Sequence & Methodology

- Perimeter Basement Wall Construction Ongoing
- ERSS Support Struts Being Removed in Coordination with Basement Wall Construction
- Sheet Piling Removed after Wall Completion

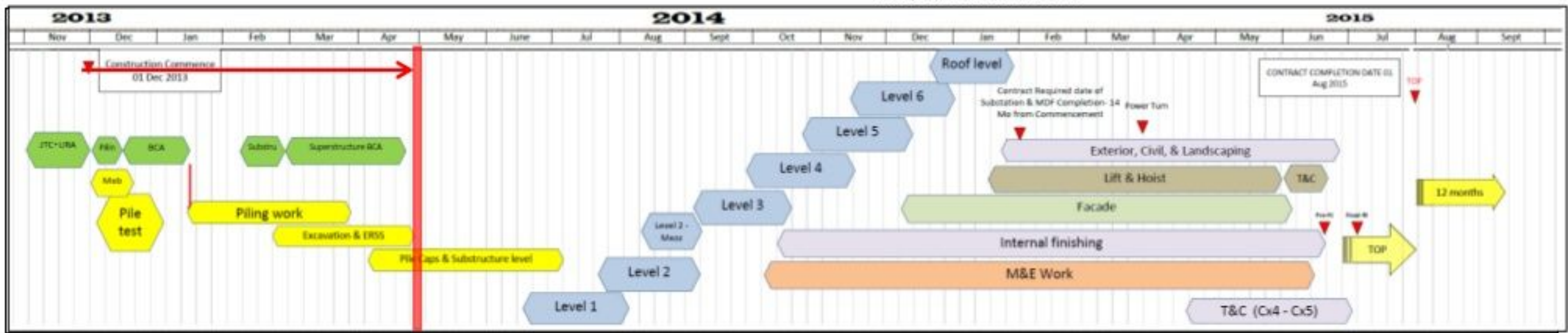








Concept Sheet Pile/Strut Detail



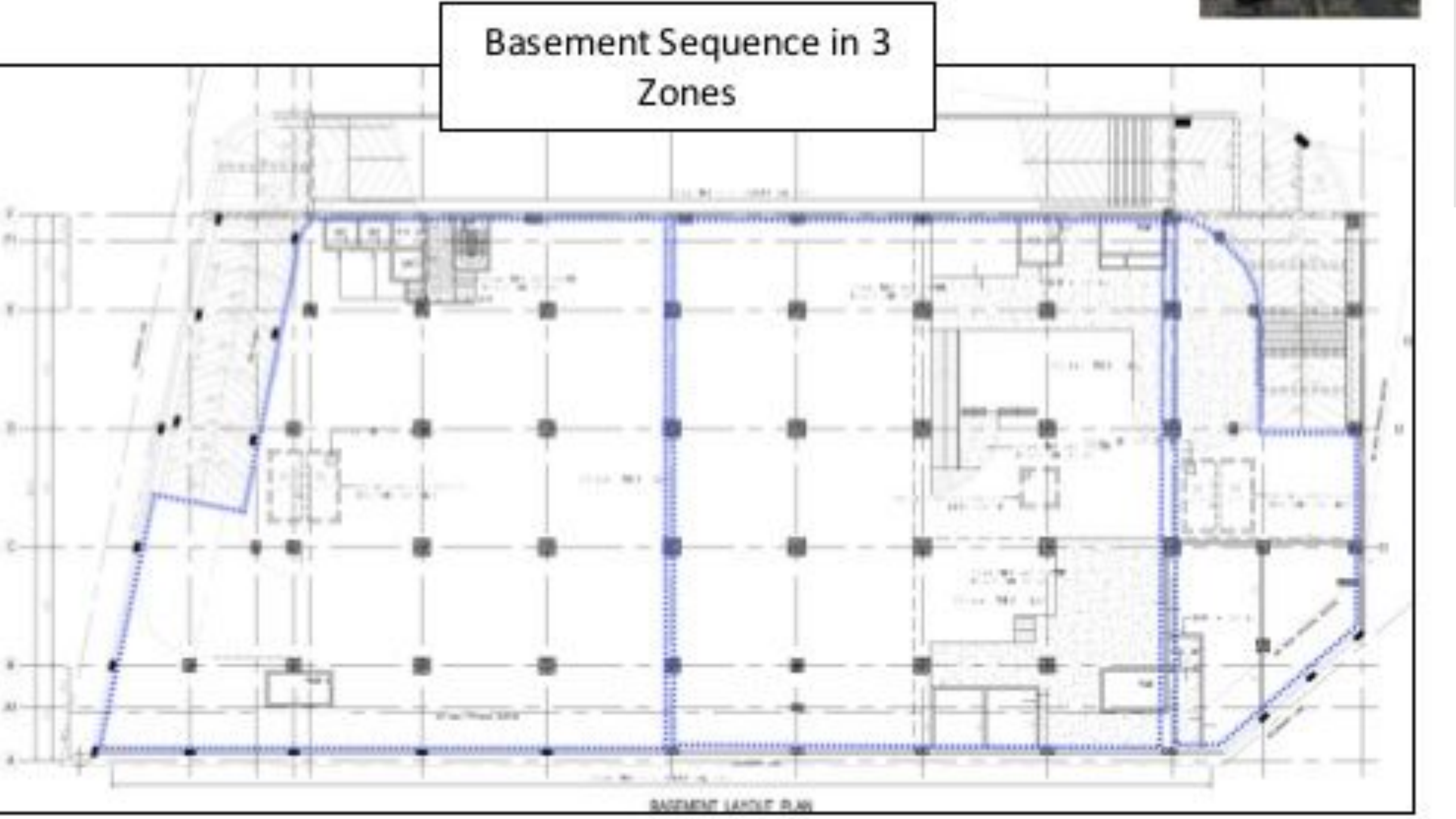
Construction Sequence & Methodology

BIM Myanmar

BIMarabia Academy

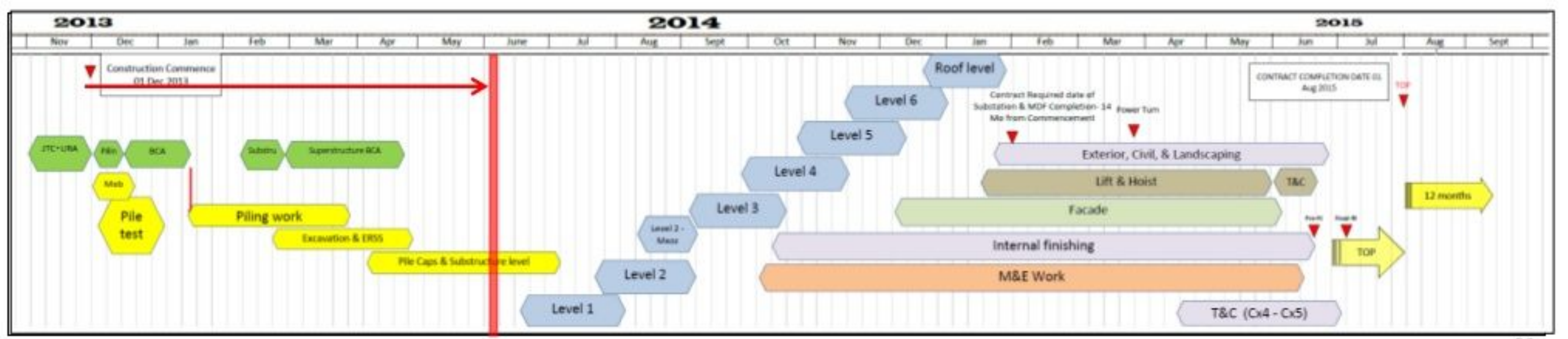
- Basement Perimeter Walls Complete.
- Ramp Construction Ongoing
- All ERSS Sheet Piling is Removed.
- Basement Columns and Elevator Shaft & Stair Walls Near Completion







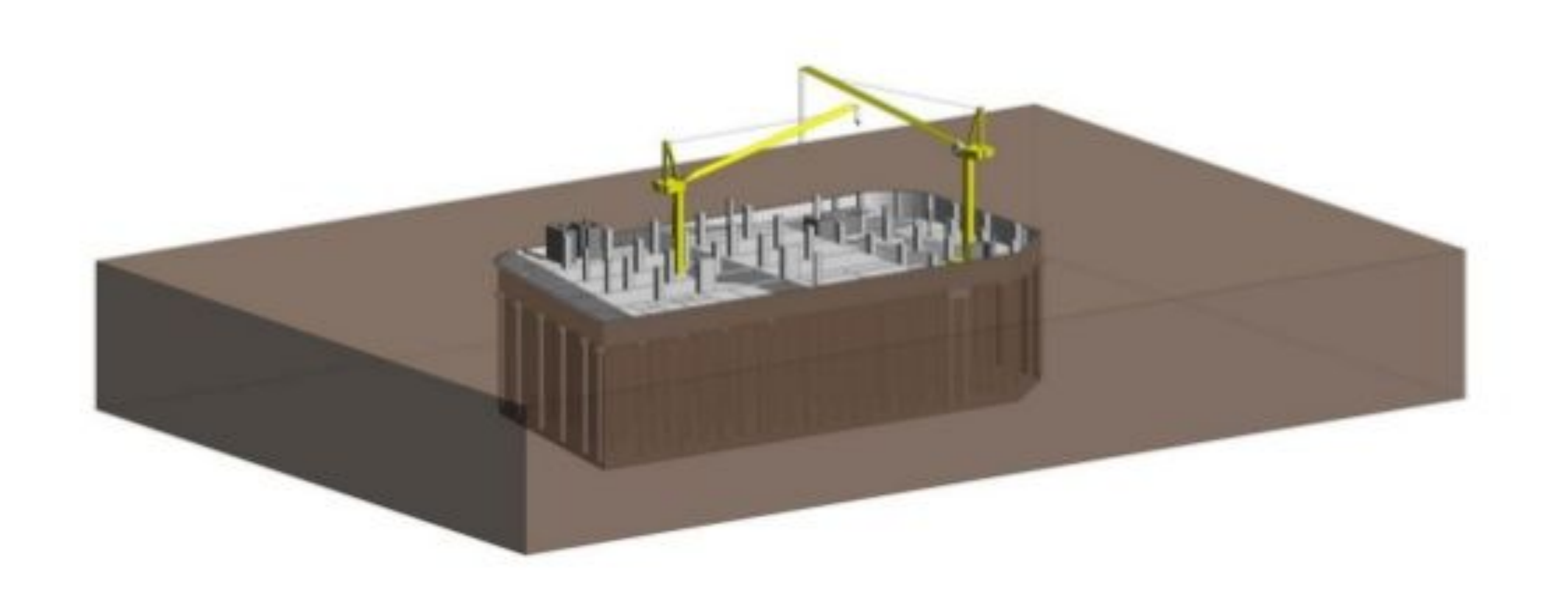
Mobile Crane / Rough Terrain Crane prior to Tower Crane Installation

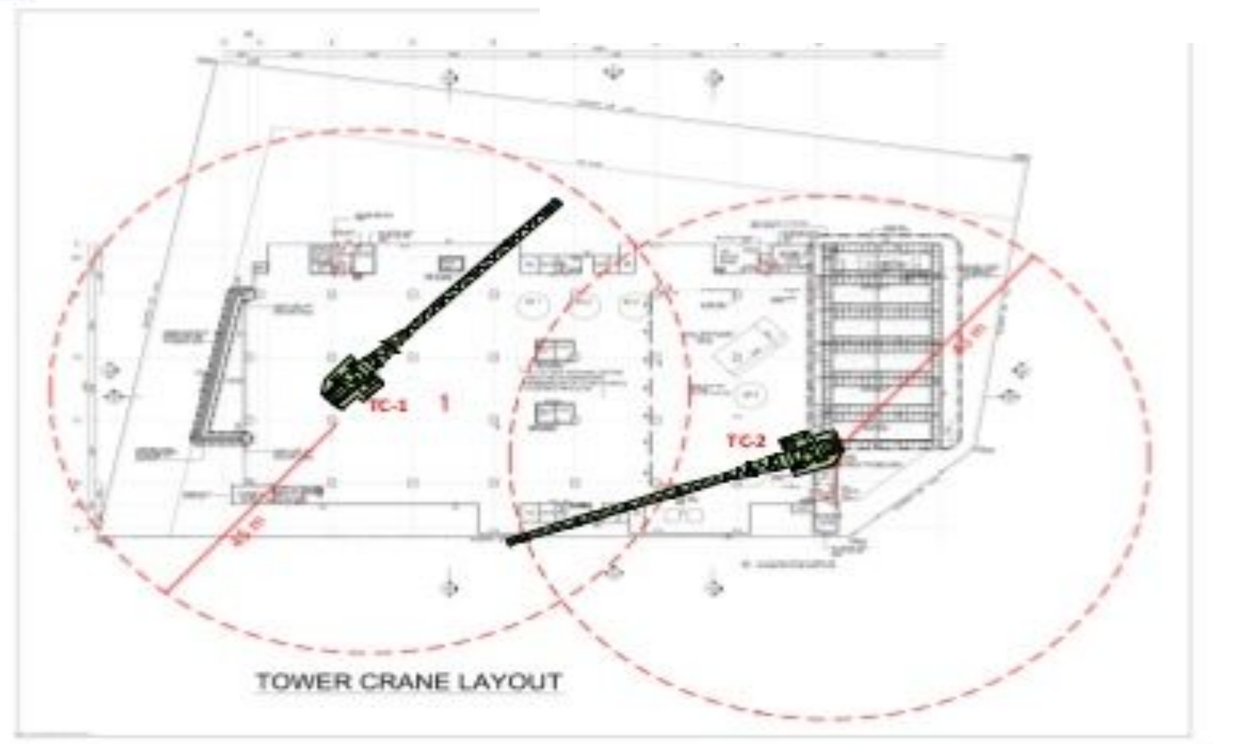




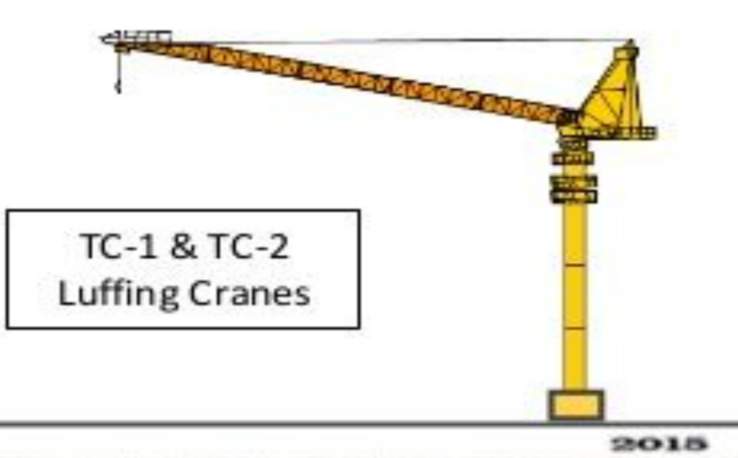
Construction Sequence & Methodology

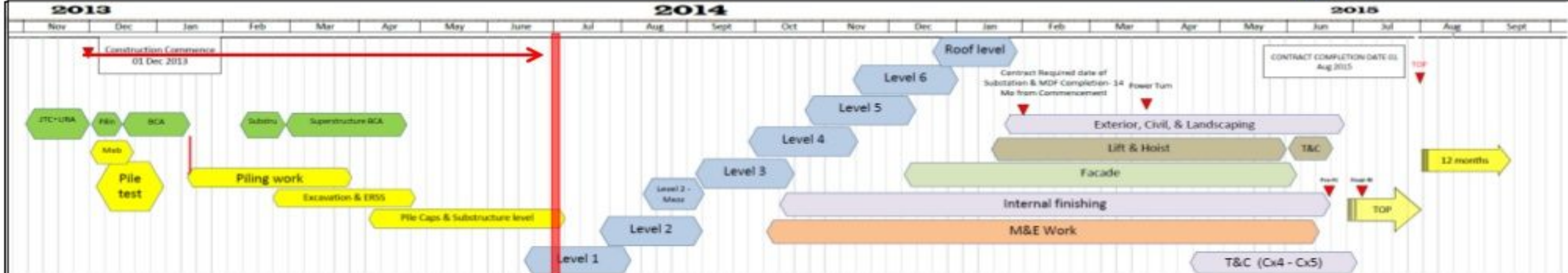
- Tower Cranes Installed
- Superstructure Construction Commence
- Level 1 Superstructure Ongoing





TC-1 & TC-2
Luffing Cranes

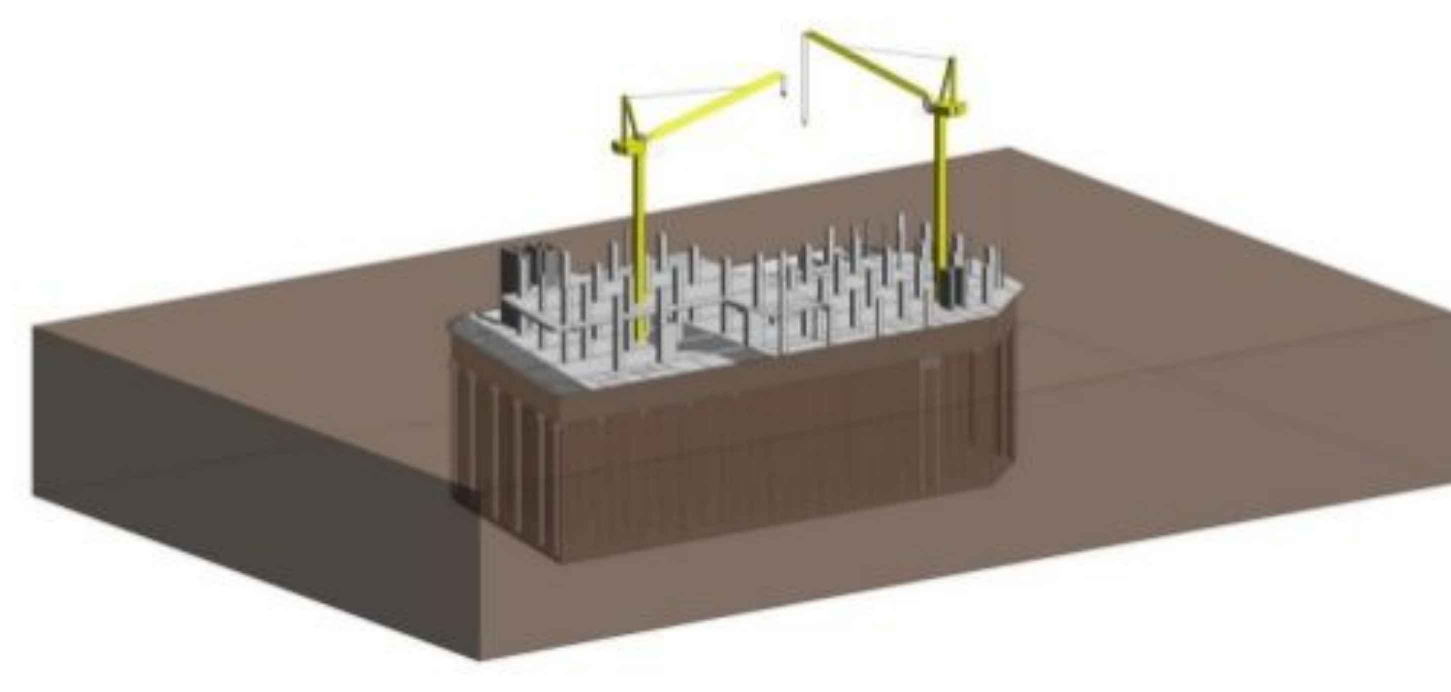






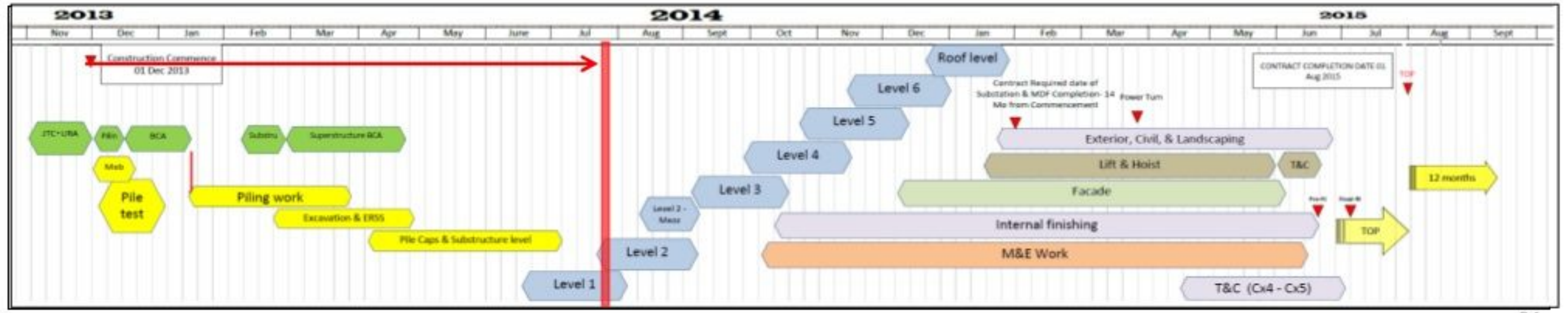
Construction Sequence & Methodology

- Superstructure Construction Ongoing
- Level 1 Complete
- Level 2 Ongoing



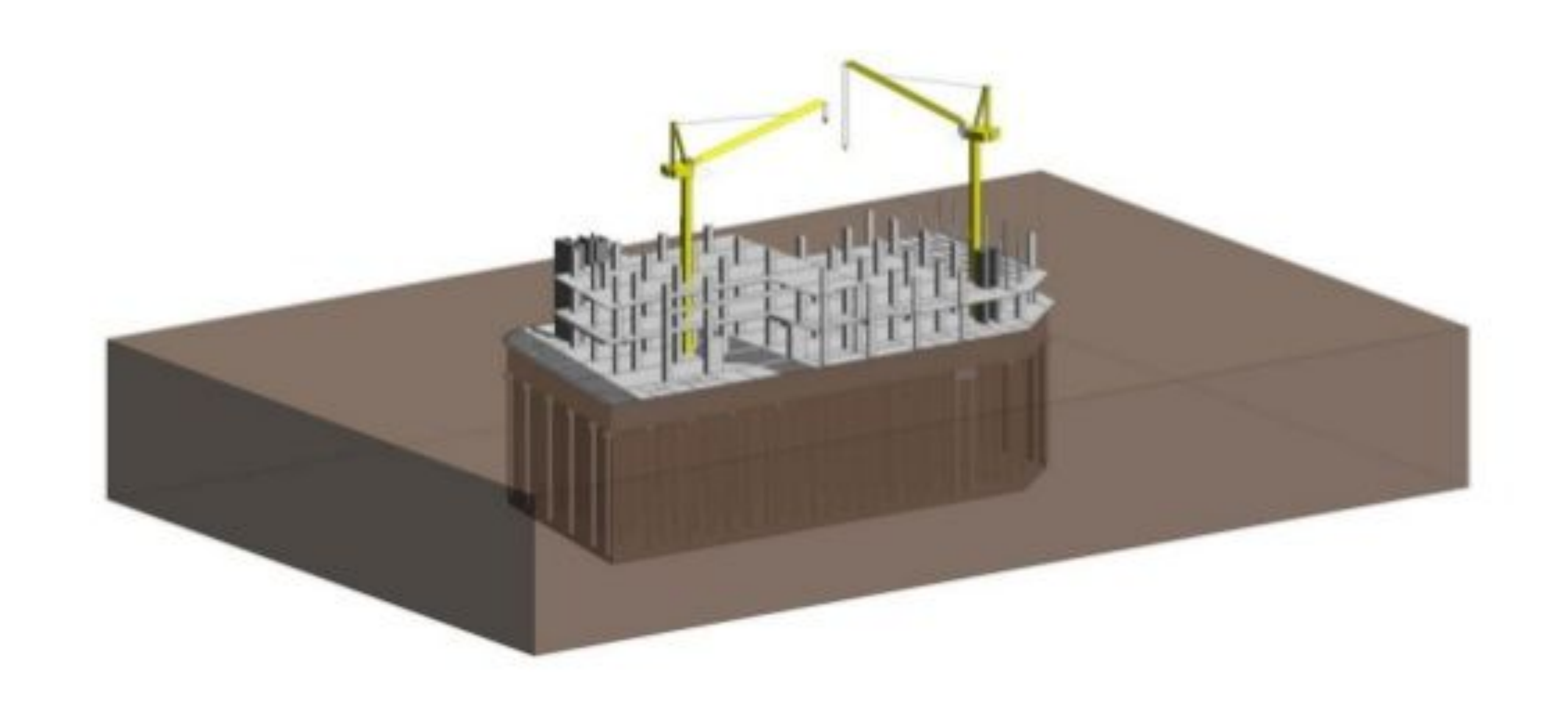


Typical Zoning for Structure Installation L2-Roof

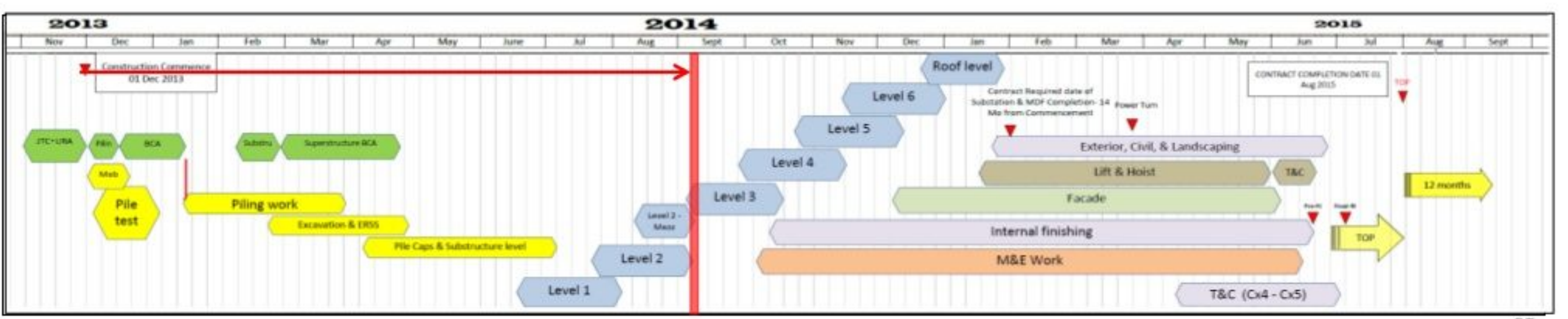




Construction Sequence & Methodology

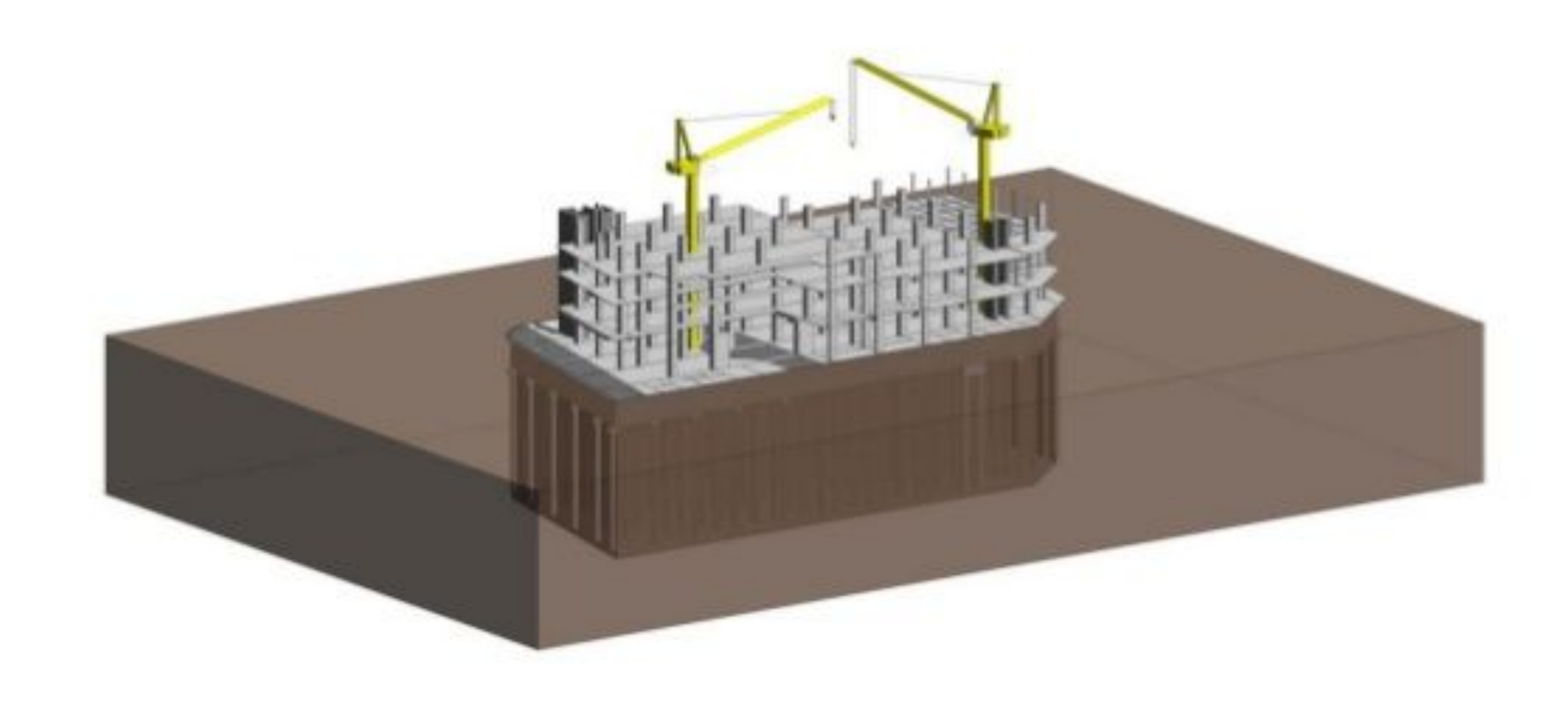


- Superstructure Construction Ongoing
- Level 2 Complete
- Level 2 Steel Structure Complete
- Level 3 Ongoing

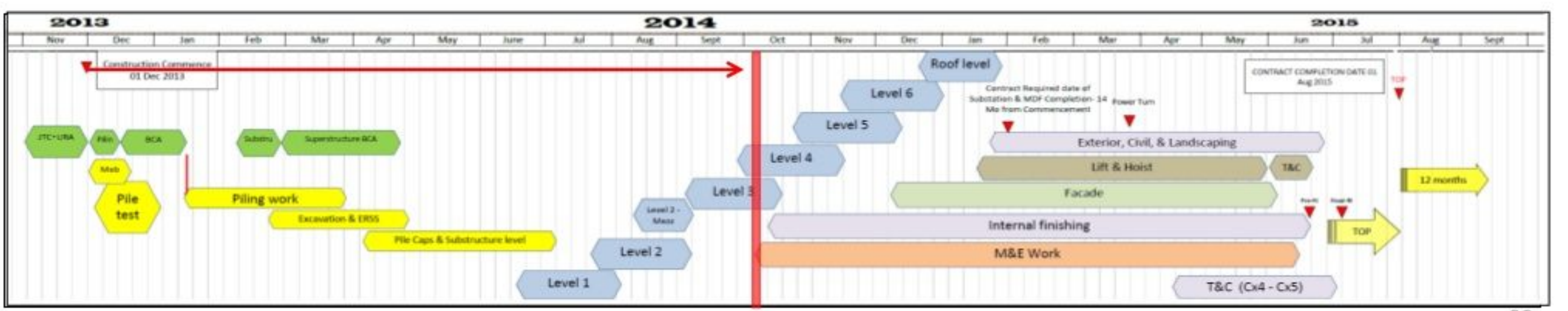




Construction Sequence & Methodology



- Superstructure Construction Ongoing
- Level 3 Complete
- Level 3 Steel Structure Complete
- Level 4 Ongoing
- Interior Work and M&E work Commencing in Lower Levels.

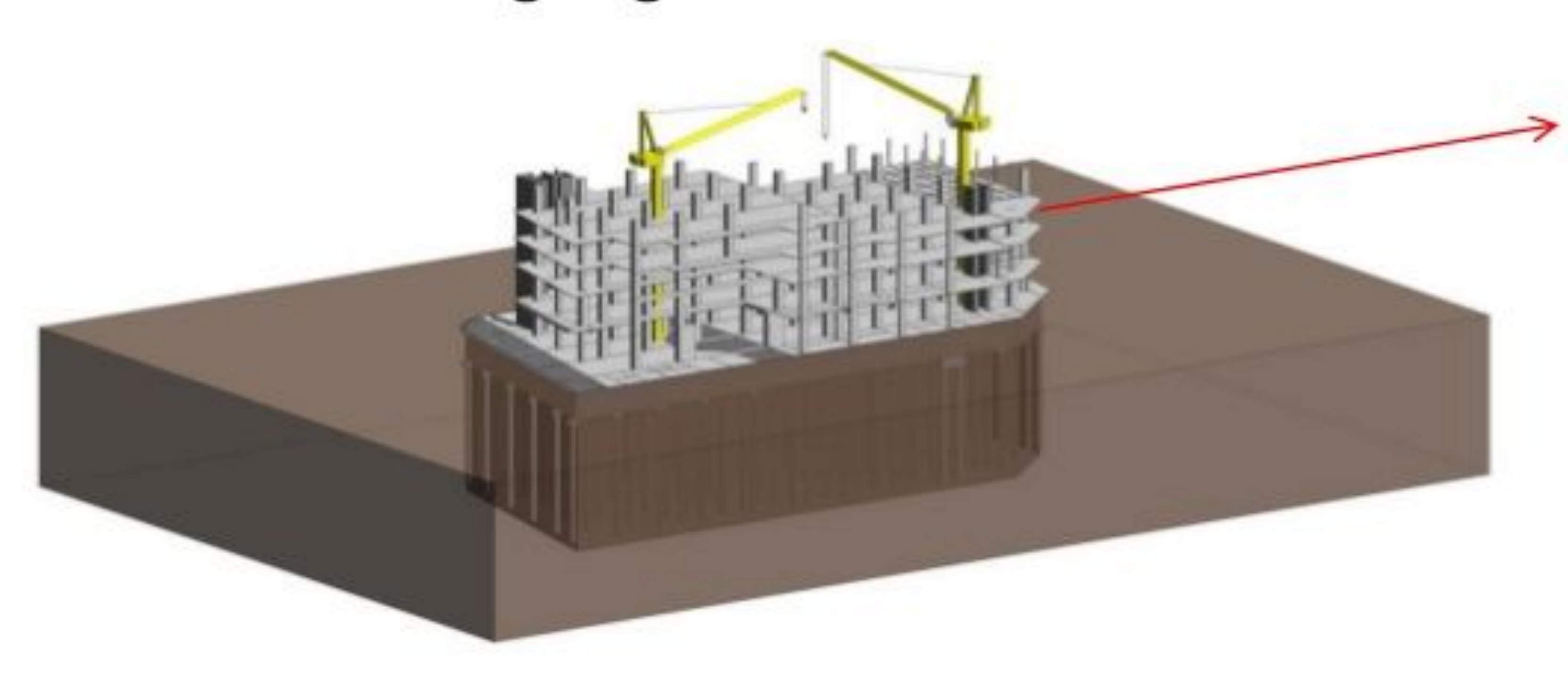


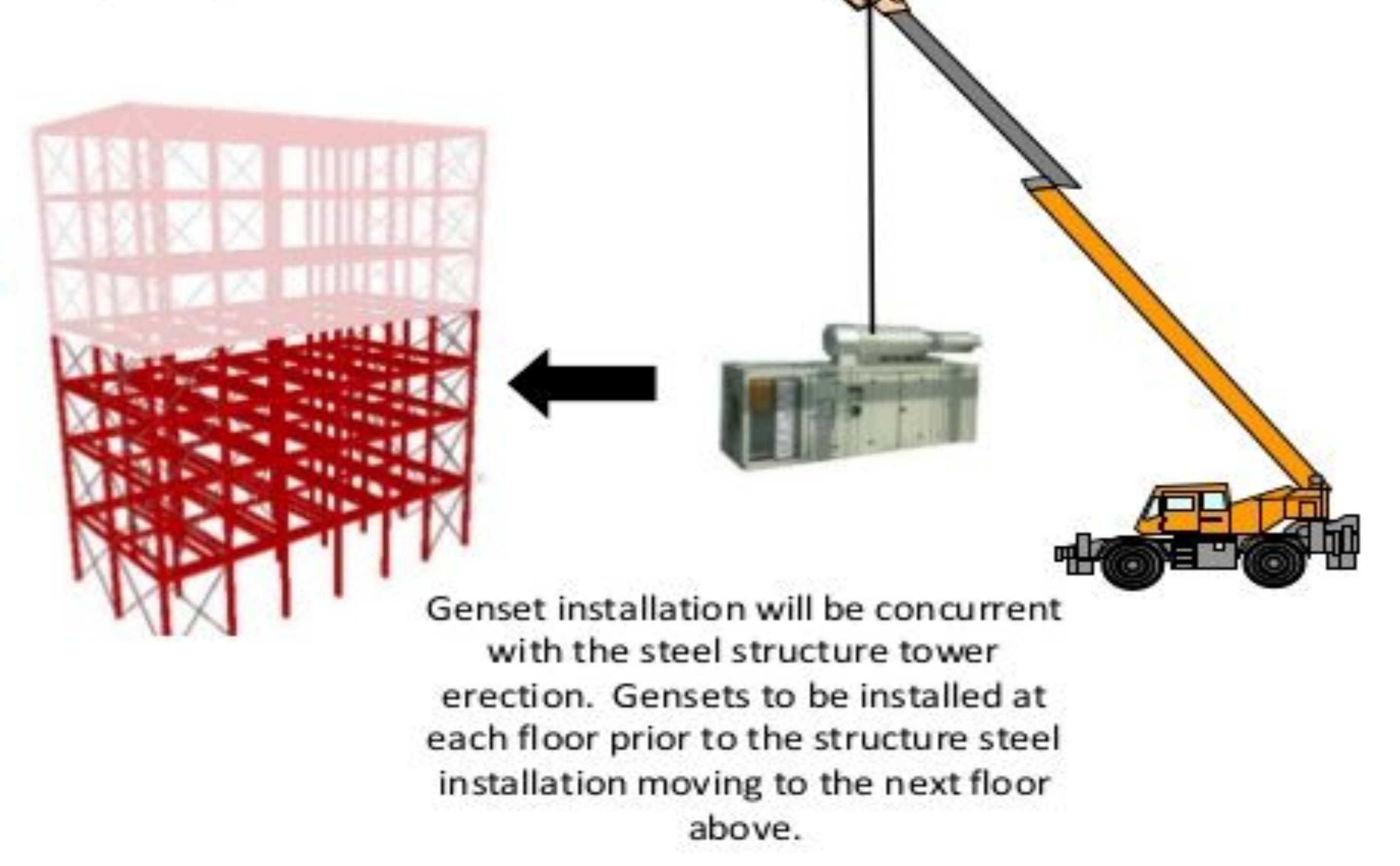


Construction Sequence & Methodology

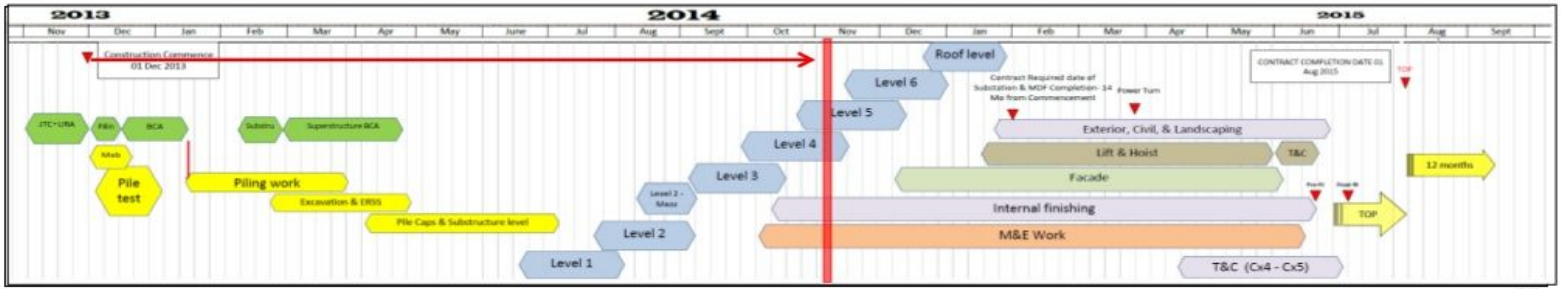
- Superstructure Construction Ongoing
- Level 4 Complete
- Level 4 Steel Structure Complete
- Level 5 Ongoing

- Interior Work and M&E work Ongoing.





Genset installation will be concurrent with the steel structure tower erection. Gensets to be installed at each floor prior to the structure steel installation moving to the next floor above.

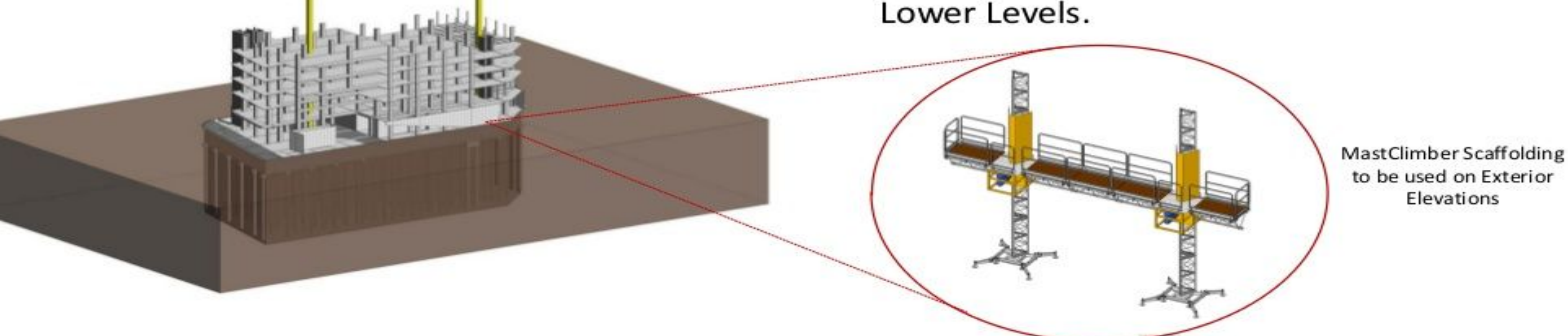


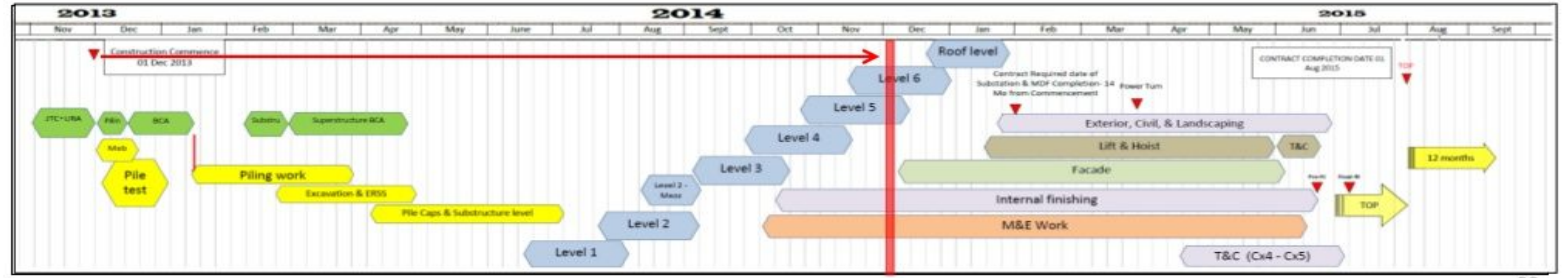


Construction Sequence & Methodology

- Superstructure Construction Ongoing
- Level 5 Complete
- Level 5 Steel Structure Complete
- Level 6 Ongoing

- Interior Work and M&E work Ongoing.
- Steel Support for Façade Installation Commence
- Façade Installation Commencing at Lower Levels.



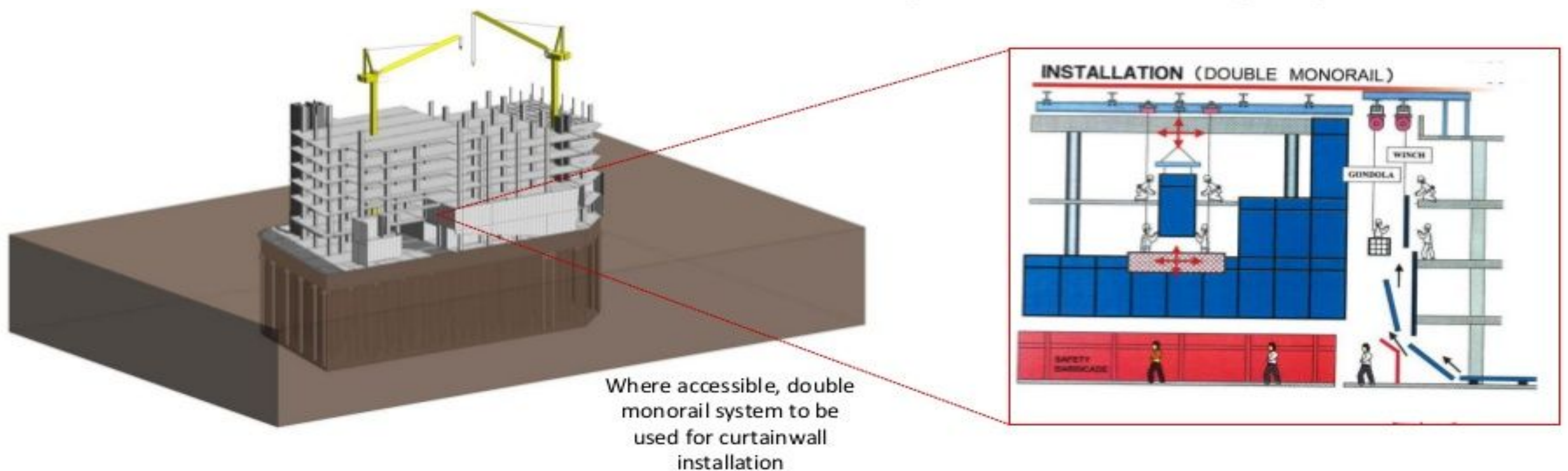




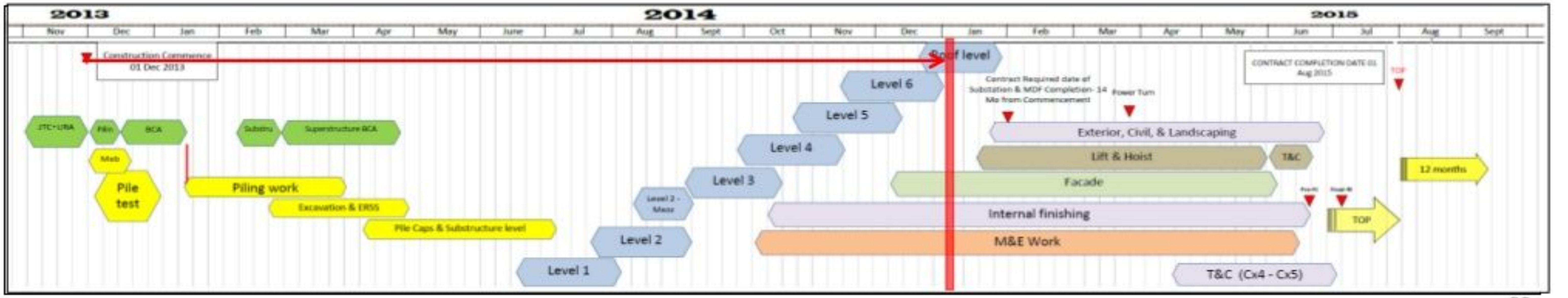
Construction Sequence & Methodology

- Level 6 Complete
- Level 6 Steel Structure Complete
- Roof Slab Ongoing

- Interior Work and M&E work Ongoing.
- Façade Installation Ongoing

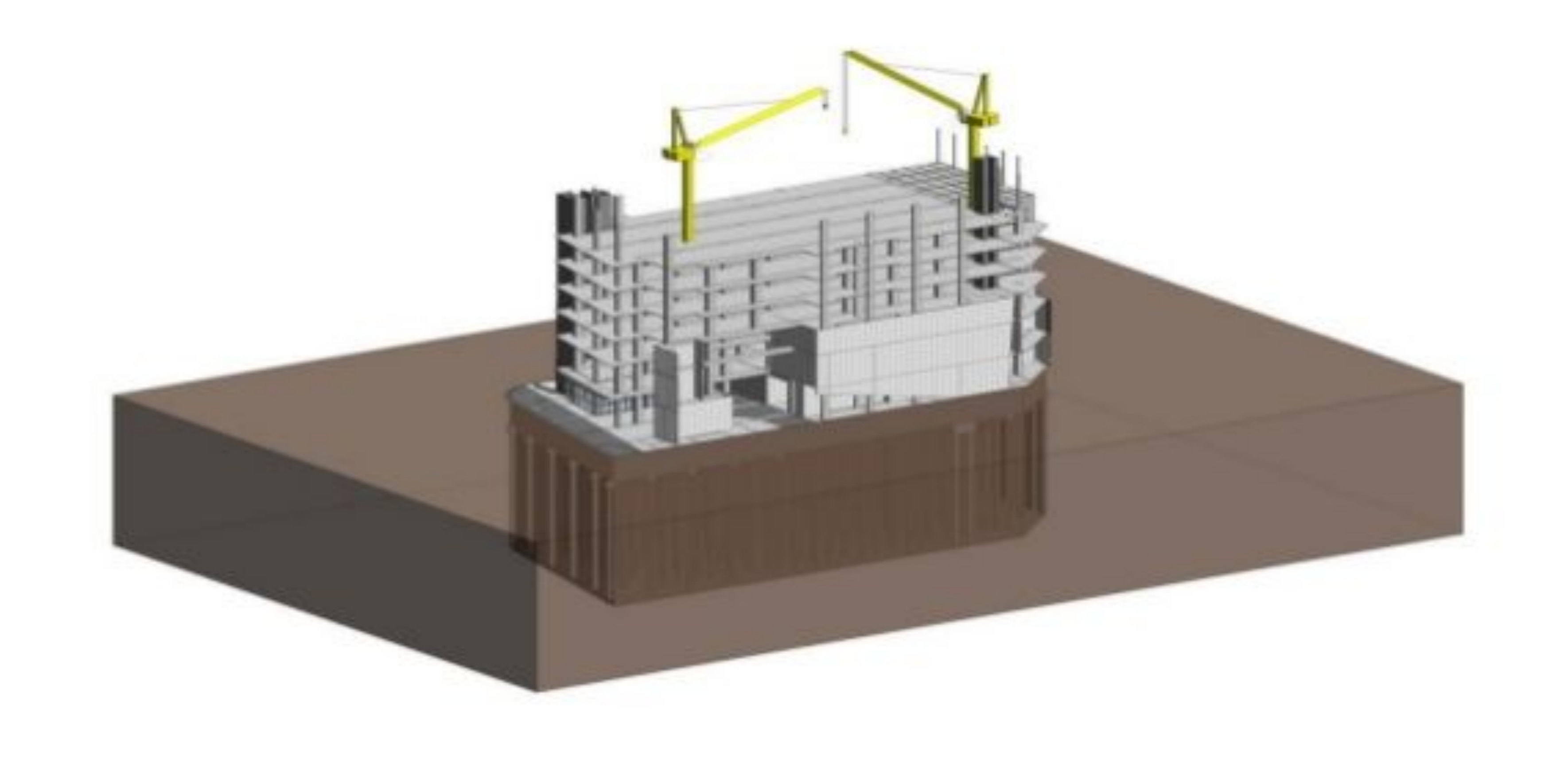


Where accessible, double monorail system to be used for curtainwall installation

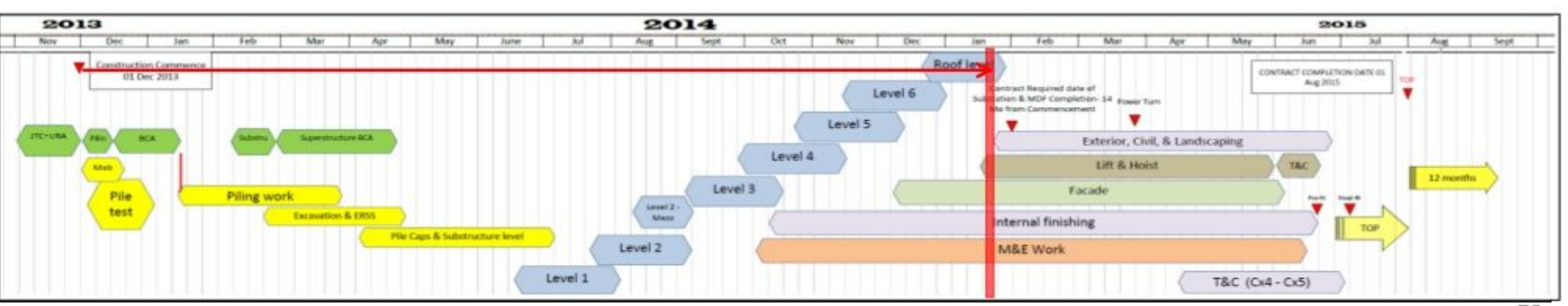




Construction Sequence & Methodology

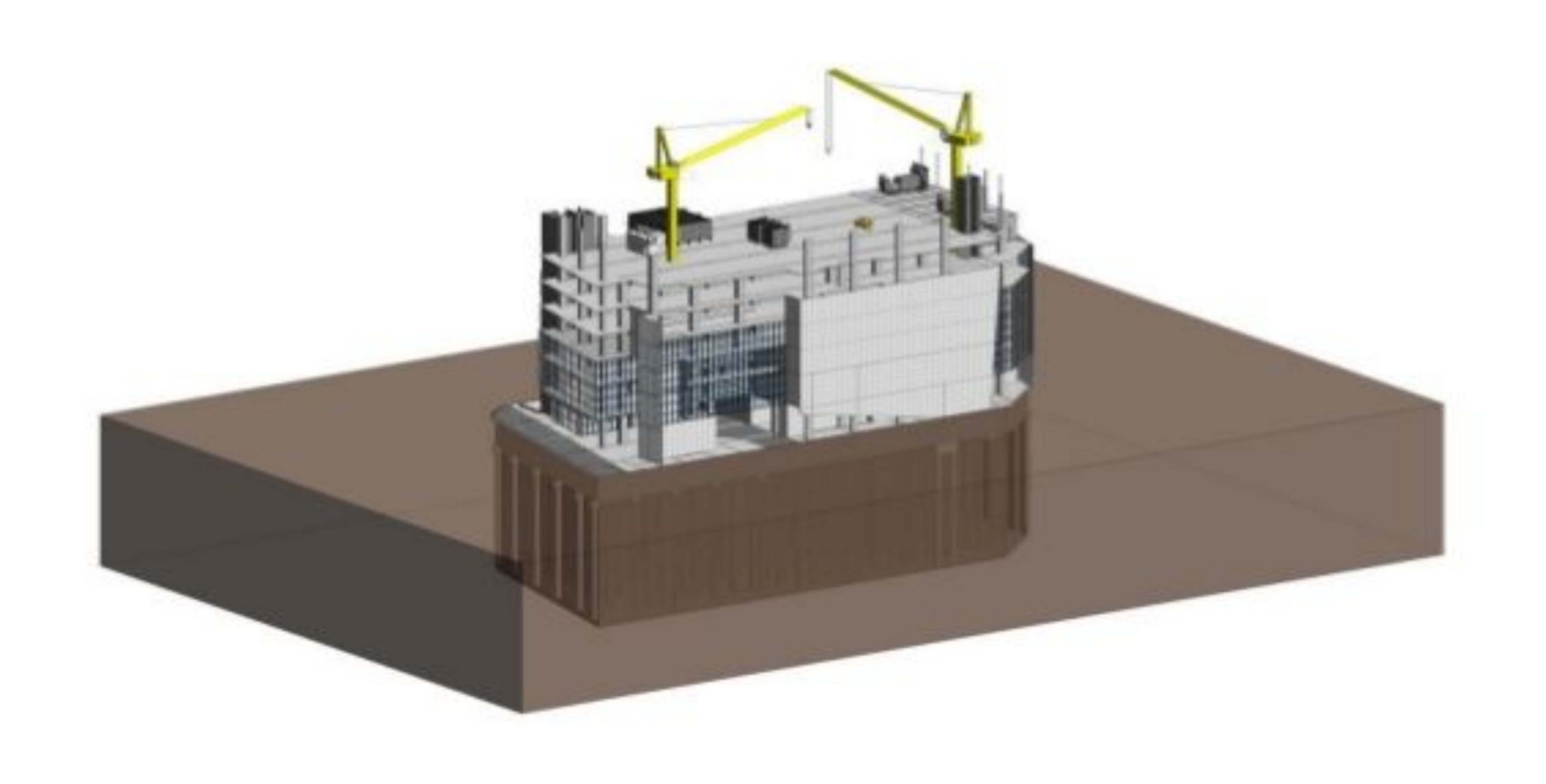


- Interior Work and M&E work Ongoing.
- Façade Installation Ongoing
- Roof Slab Ongoing

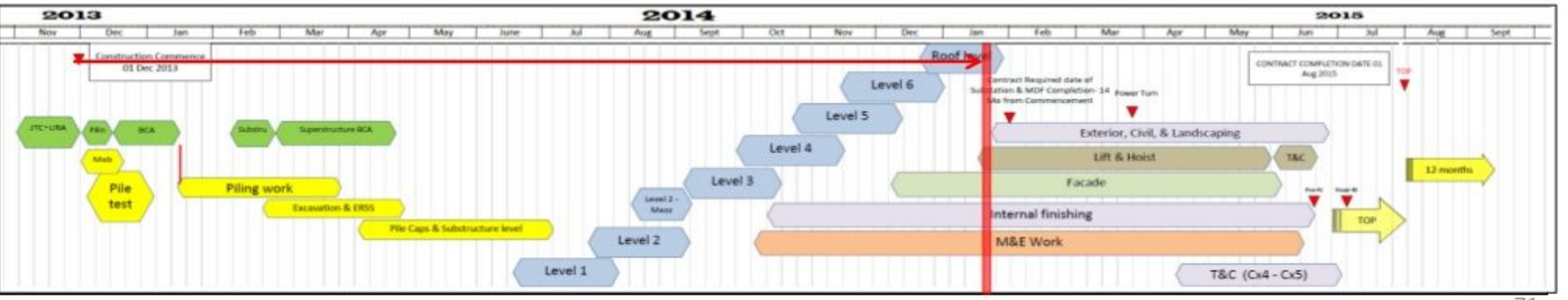




Construction Sequence & Methodology



- Interior Work and M&E work Ongoing.
- Façade Installation Ongoing
- Roof Slab Complete
- M&E Roof Structures Ongoing.
- Roof Level M&E Commencing

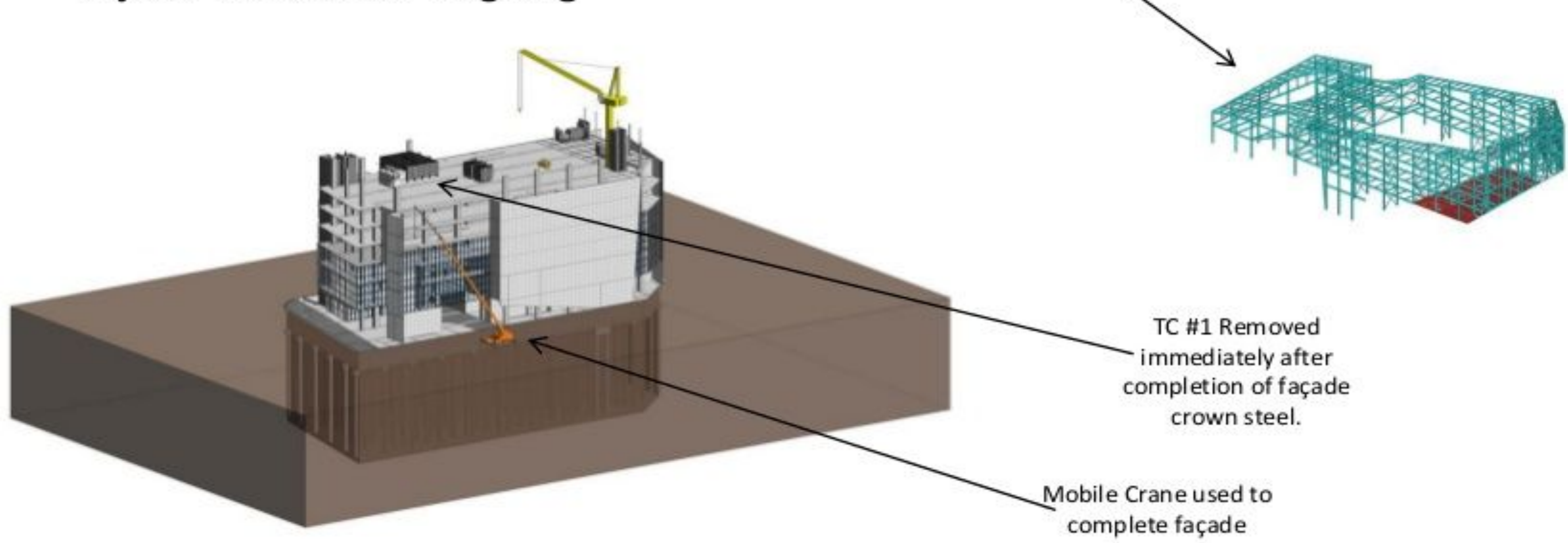


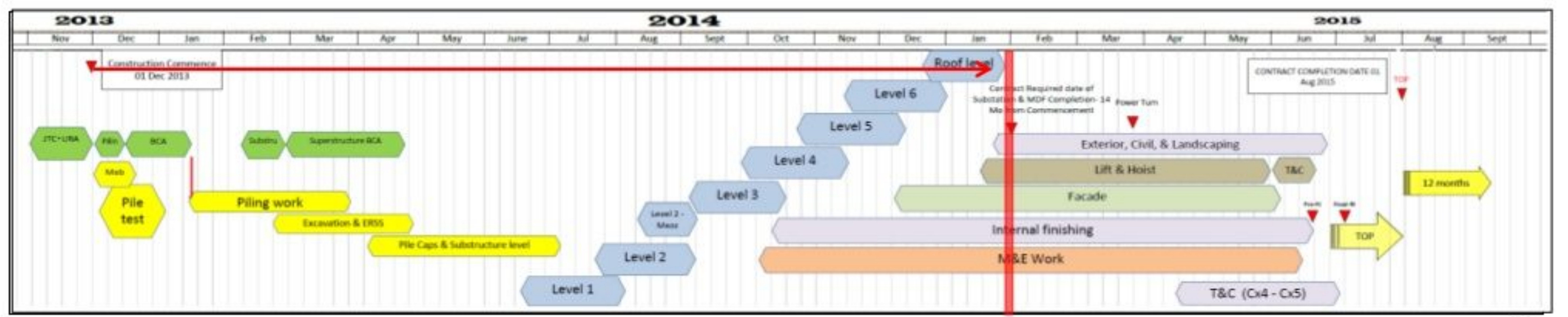


Construction Sequence & Methodology

- Interior Work and M&E work Ongoing.
- Façade Installation Ongoing

- Roof Level M&E Commencing
- Support Steel for Façade Crown Ongoing



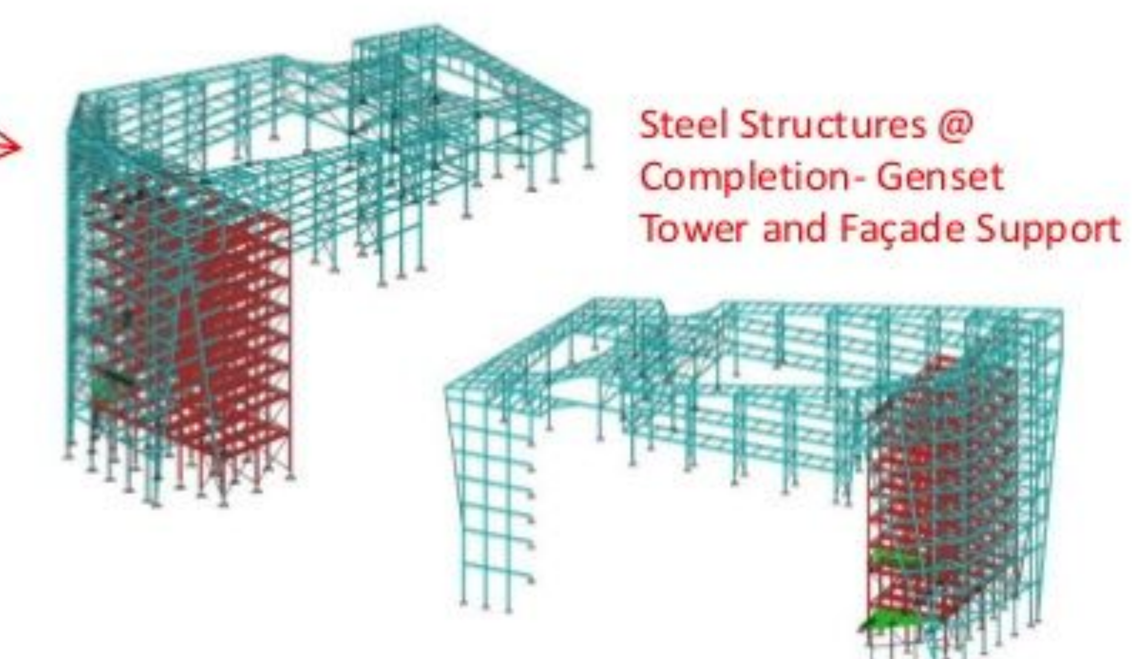


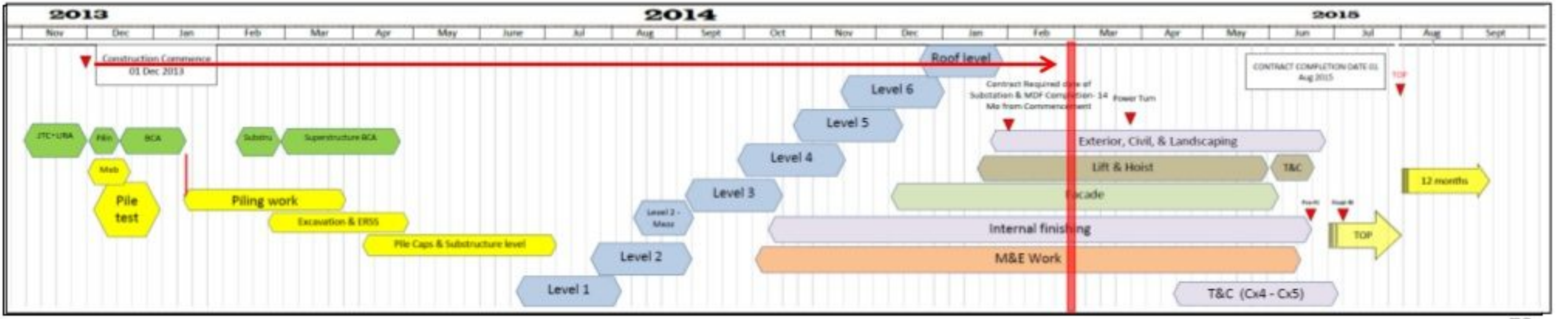


Construction Sequence & Methodology

- Lift Installation Commence
- Support Steel for Façade & Roof Façade Crown Near Completion

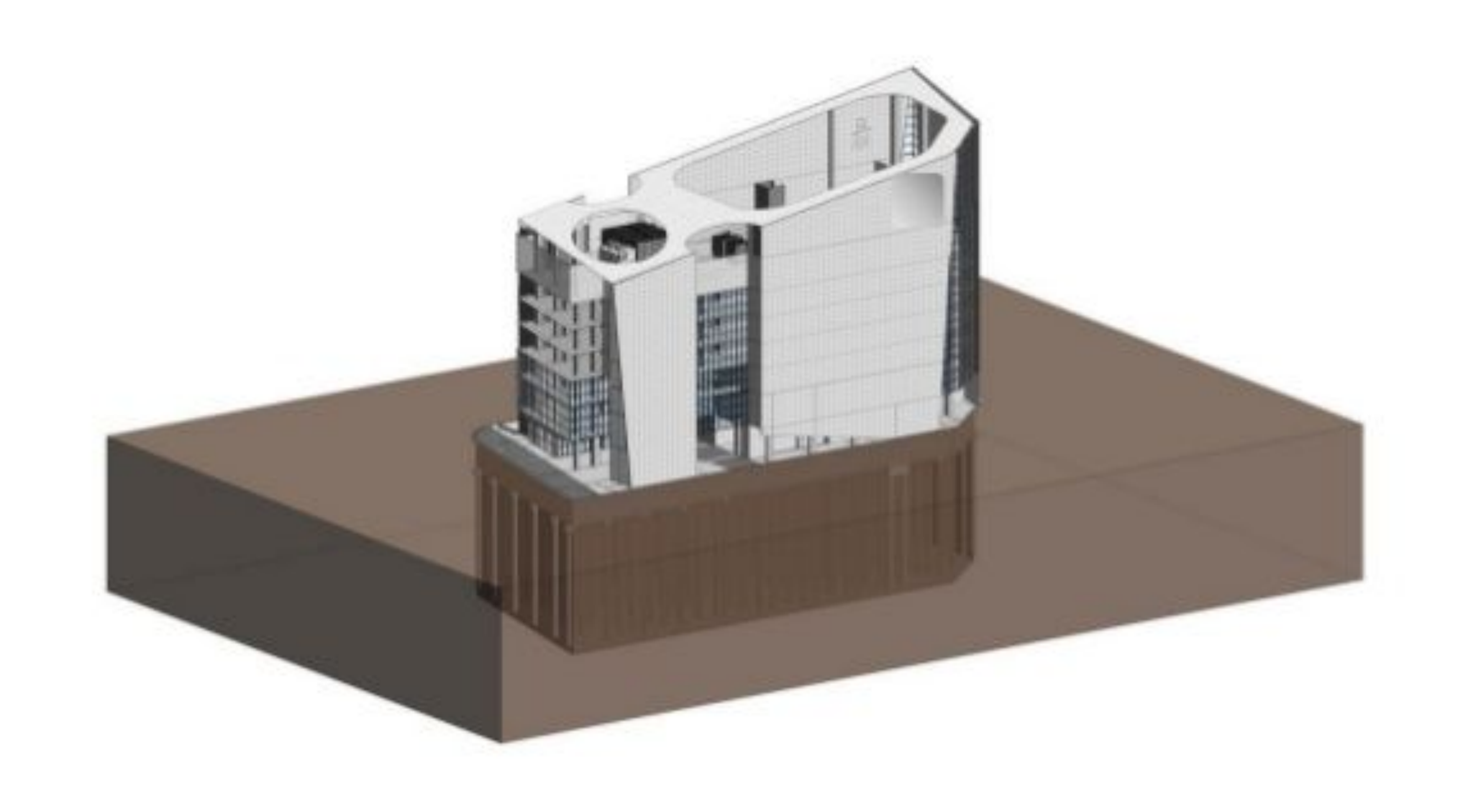
- Interior Work and M&E work Ongoing. Roof M&E Work Ongoing
- Façade Installation Ongoing
- Exterior Work Commence (Boundary Wall)



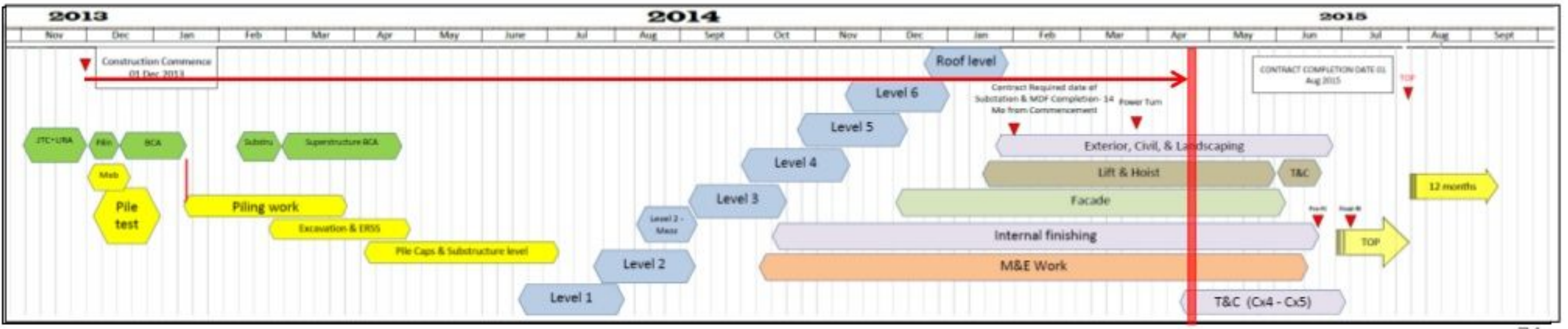




Construction Sequence & Methodology

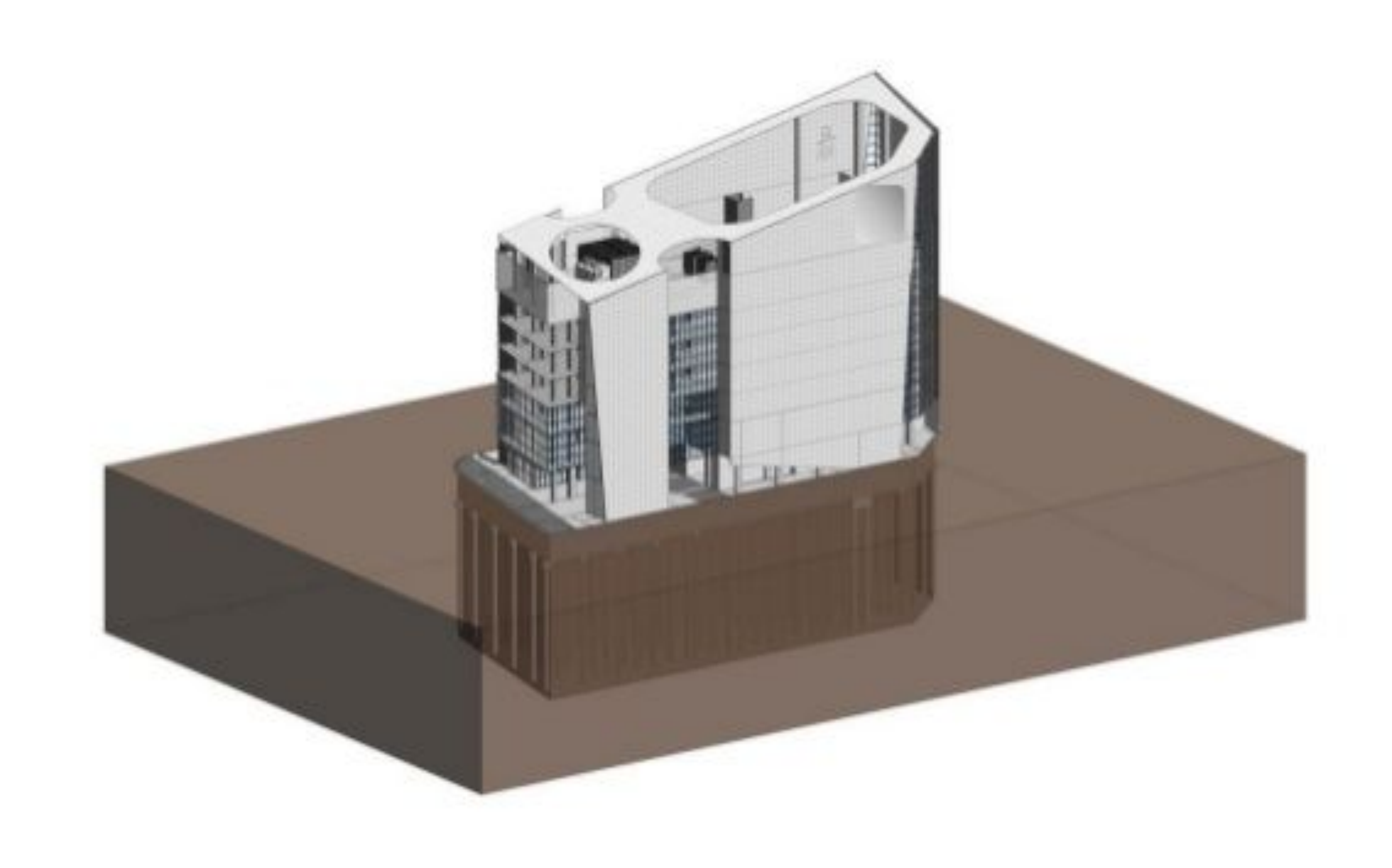


- Exterior Work Ongoing.
- Lift Installation Ongoing
- Façade Near Completion
- Interior Work Ongoing
- M&E Work Ongoing.
- Permanent Power has been Established.
- Cx4 M&E Testing & Commissioning Ongoing.

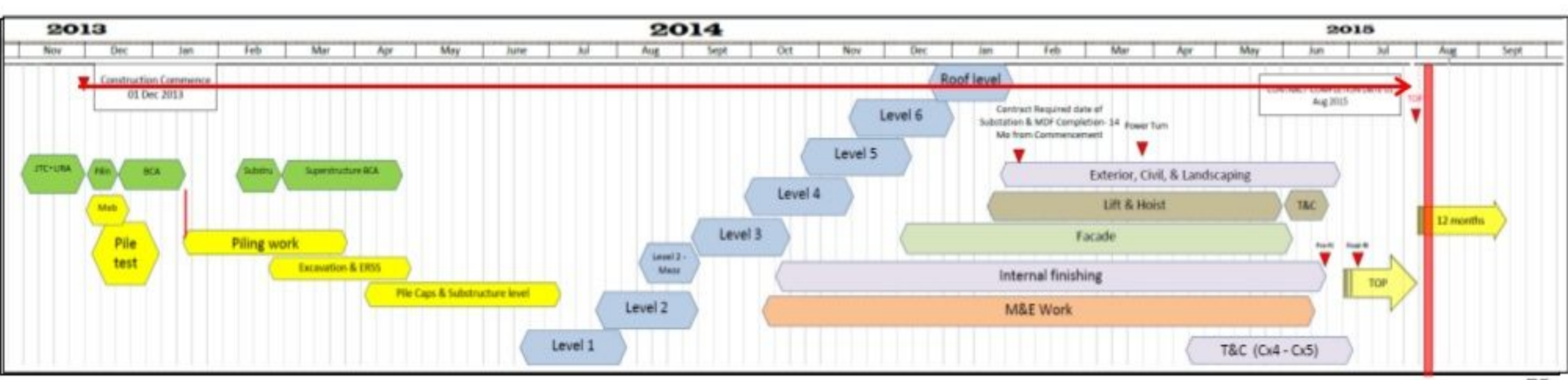




Construction Sequence & Methodology



- Exterior Work Complete
- RI Inspections Completed
- TOP ISSUED!





Benefits of Construction Simulation:

- Powerful Visualization of Construction Process (Problem Forecast before construction)
- Improved Construction Planning & Management (Better Understanding of Project Milestones)
- Effective Bidding Presentation (Winning New Projects & Clients)
- Streamlined Construction Productivity (Reduced Cost & Error)
- Competent Execution of Construction Process (Coordinating Detailed Construction Operations)
- Efficient Logistics Management (Safe work environment for all site workers)
- Effective Building Site Space Utilization (Resolving Space Conflicts)
- Effective Project & Risk Management (Monitoring Plan & Tracking the Actual Progress)



Questions ?

Omar Selim